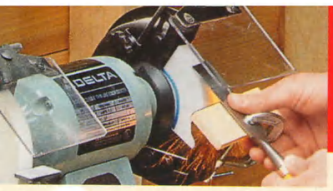

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Vol. 34 / No. 201

SHOP-BUILT ROUTER JIG
Makes Seat Sculpting a Snap!

INSIDE!

The Perfect Hardware for Your Next Project

Surprising Softwood— All About Pine

Low-Cost Shop Upgrade with Big Impact!

A Publication of August Home Publishing

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weekend project

Heirloom Flag Case 18

Here's a great way to feature a presentation flag. To create a truly unique project, you can build a stylish base to match or add a lid to hold awards and decorations.

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Wall-Mounted Desk 26

This hanging desk is the perfect choice for adding a small office work area on any wall. The compact design provides an ample work-surface with drawers for storage.

shop project

Adjustable Shop Stool 34

Every shop needs a stool — and this one is top-notch. You can adjust the height with a simple spin of the comfortable, scooped seat. Plus, the elegant design means you'll want to build a few for inside the house, as well.

Adjustable Shop Stool page 34

editor's note

Sawdust

One of the more enjoyable parts of my job is reading through the letters and emails from readers. The comments and questions cover a wide range of topics, from saying how much they enjoyed the latest issue to sending in a photo or two from a recently completed project. But the ones I really take an interest in are those requesting a specific project. We're always looking for new and interesting projects to feature. We try our best to give them all consideration for future issues. In this issue, we address a request that we've received numerous times — a flag case.

The flag case featured on page 18 was a design that evolved over time. While the flag case starts out as a basic triangular box, it's dressed up around the edges with brass highlights. Plus, you can turn the flag case into something really special by adding a lid to display medals and mementos. We even designed a stylish base to create a one-of-a-kind project — a fitting honor for the person to whom the flag was awarded.

One of the other projects addressed the needs of our design director, Ted. He was tired of the old, shabby, metal stool he had in his shop, so he designed and built the one you see at left. It's a classic oak stool with an adjustable seat. After seeing Ted's prototype, a few of us thought it would be a great project for *Woodsmith*. And with its curved legs and scooped-out seat, I expect you might see a stool (or two) like this showing up in a few kitchens or entertainment areas pretty soon.

Thanks for all the super ideas and suggestions for future projects. Keep sending them in, and we'll do our best to find a way to feature them in an upcoming issue.

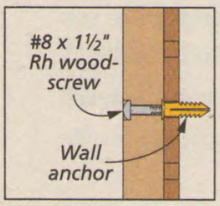
Bryan

Woodsmith GO ONLINE EXTRAS

This symbol lets you know there's more information online at Woodsmith.com. There you'll see step-by-step videos, technique and project animation, bonus cutting diagrams, and a lot more.

Tips & Techniques

Angled Pegboard Storage



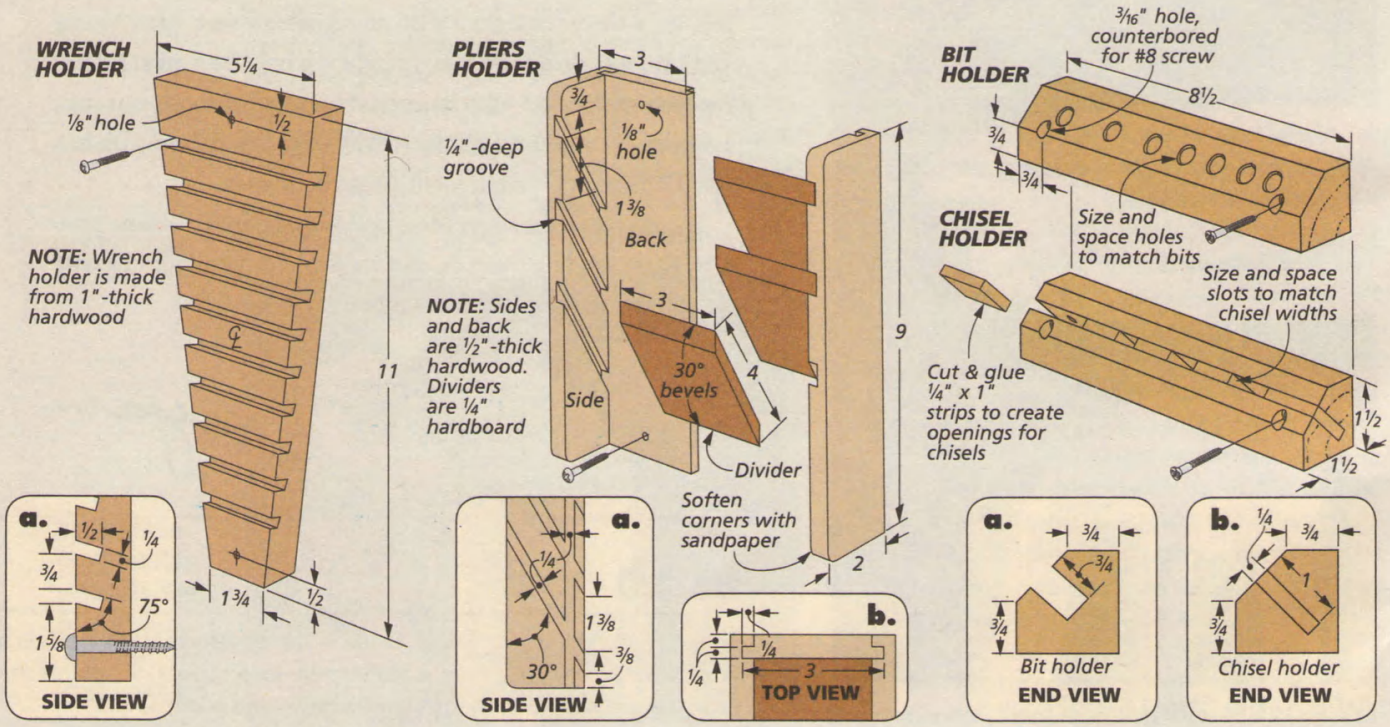
Anchor. *Drive screws into wall anchors to secure holders.*

Pegboard is a storage fixture in my shop. The only problem is, I use it so much that it doesn't take me long to fill the entire board with tools.

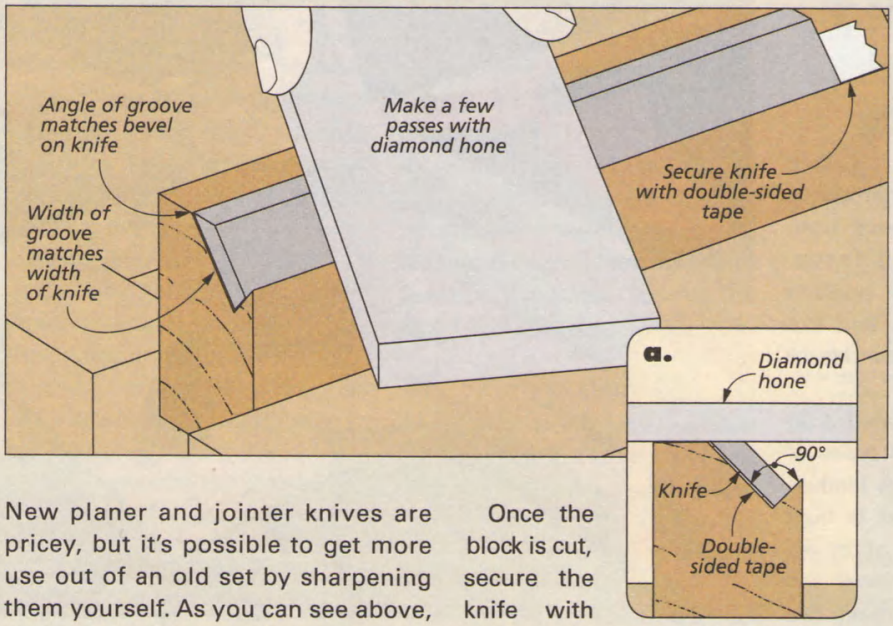
To free up some extra space, I made blocks that hold tools and accessories at an angle to the pegboard. Now, items like chisels and pliers only take up a few square inches of space on the pegboard instead of a few square feet. Plus, the angle makes it easier to remove the items you need from the board.

As you can see in the photo above and illustrations below, the concept is simple and can be modified for whatever tool you need to store. To mount the blocks, insert wall anchors in the pegboard holes. Then drive screws through the holders and into the anchors to secure them (see the illustration at left).

Edward Stiles
Lawton, Oklahoma



Simple Knife Sharpening Block

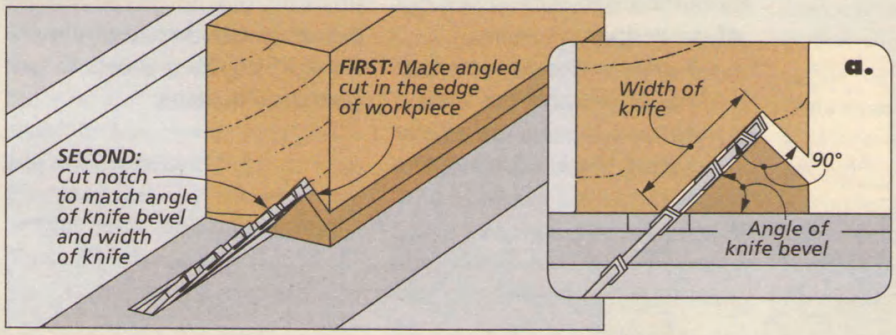


New planer and jointer knives are pricey, but it's possible to get more use out of an old set by sharpening them yourself. As you can see above, you just need a notched block that holds the knife at the proper angle.

To make the block, first measure the width of the knife and the angle of the knife's bevel. Then lay out the mating angles of the notch on the end of the block, and make a couple of angled rip cuts on the block as shown in the drawings below.

Once the block is cut, secure the knife with tape so the bevel is a hair proud of the top face of the block. (The bevel should be parallel with the top face of the block.) Using a super-fine diamond hone, make a few passes over the bevel to sharpen it (illustrations above).

Rich Flynn
Huntington Beach, California



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Featherboard Jig

When making rip cuts, it's often helpful to have featherboards supporting the workpiece from both the side and top. Side support keeps the board pressed against the rip fence, and top support prevents the board from "climbing" the blade.

DUAL-FUNCTION JIG. I created a jig that incorporates both types of featherboards (right). A featherboard for side support is built into the plywood base of the jig. And an adjustable arm allows you to position a featherboard above the workpiece. The base of the jig has two switchable magnets built into it, so you can position the jig anywhere on the surface of the table saw.

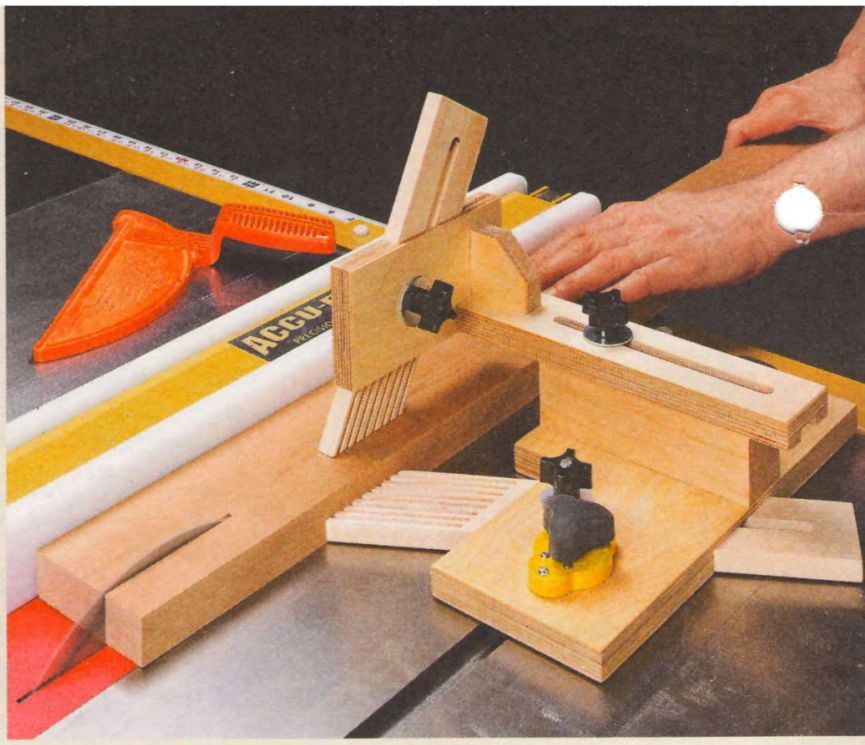
BUILD THE JIG. To make the jig, cut all the parts to size on the table saw. Then rout slots in the faces of the arm and the two featherboards to make them adjustable (drawings below).

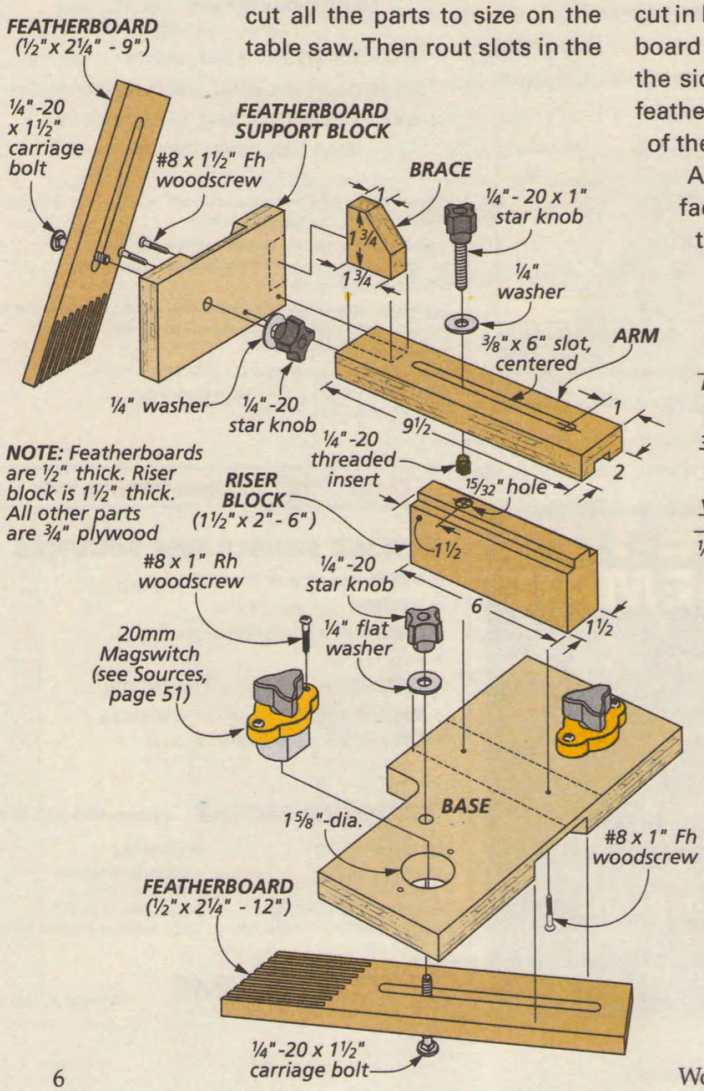
To accept the featherboards, there are wide, angled dadoes cut in both the base and featherboard support block. A notch on the side of the base allows the featherboard to slide in and out of the dado more easily.

A groove along the bottom face of the arm fits over a tongue on the top of the riser block. I formed the tongue by cutting rabbets on the top edges of the riser block. Make sure the fit of all the parts allows for smooth and easy adjustments.

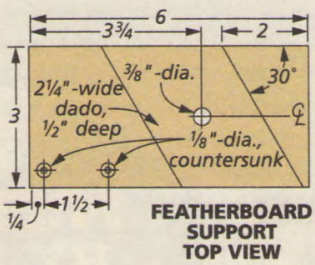
Once all these cuts are made, you just have to drill a few holes and add the hardware shown in the illustrations. Then you can position the jig anywhere on the table saw top, and simply "switch" on the magnets to lock it securely in place.

Fred Adams
Henderson, New York

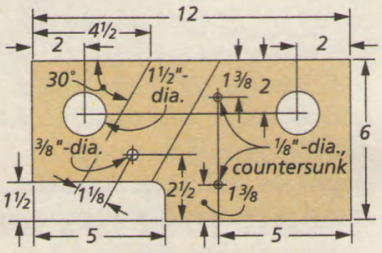




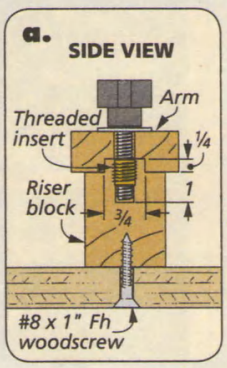
NOTE: Featherboards are ½" thick. Riser block is 1½" thick. All other parts are ¾" plywood

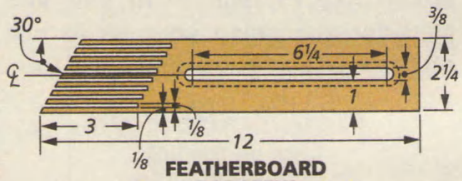


FEATHERBOARD SUPPORT TOP VIEW

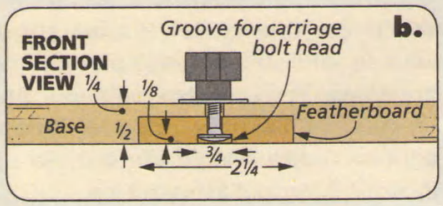


BASE BOTTOM VIEW





FEATHERBOARD TOP VIEW



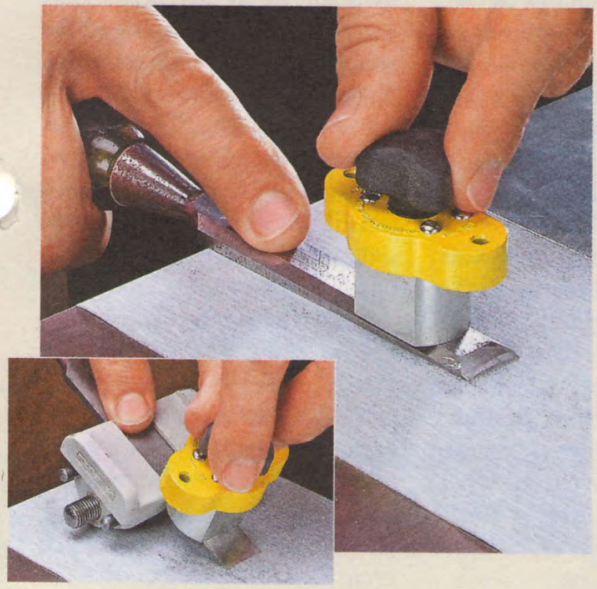
Easy Epoxy Dispenser

Epoxy is useful for many woodworking tasks, but mixing it in a cup and applying it with a brush can get messy. When I only need a small amount of epoxy for a job like filling a void, I found there's an easier way.

I simply mix the epoxy resin and hardener in a sandwich bag by kneading them together with my fingers. Then I quickly snip the corner of the bag and dispense the epoxy right where I need it (photo, right).

The bag also makes cleanup a snap. When you're done, set the bag aside until it hardens. Then just throw it in the trash.

Stephen Shaw
Long Beach, California



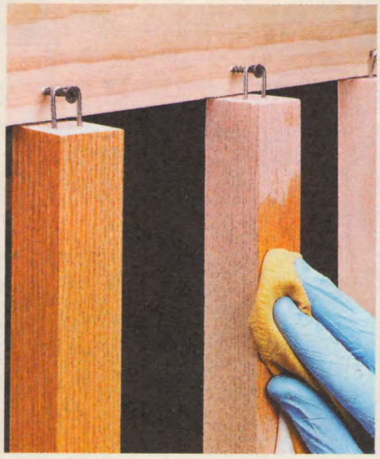
Simplify Sharpening

I've found a lot of good uses for switchable magnets (Sources, page 51) in my shop. A simple idea that I came up with recently is to use one as a handle while I'm sharpening chisels.

To flatten the back of the chisel, I affix the magnet to the top of the blade as I pass the chisel over the sharpening surface (main photo). Then I place the chisel in a honing guide and fix the magnet to the bottom of the blade as I sharpen the bevel (inset photo).

Bryden Dow
West Rutland, Vermont

Quick Tips



▲ *Delbert Rogge* of Dalton Gardens, Idaho, hangs posts or legs from staples so he can finish all four sides at once.

▲ Before drilling stopped holes, *Serge Duclos* of Delson, Quebec, uses a magnet to position the stop collar.

WIN THIS PORTER CABLE COMBO-ROUTER

Simply send us your favorite shop tips. If your tip or technique is selected as the featured reader's tip, you'll win a *Bosch* impact driver just like the one shown here. To submit your tip or technique, just go online to *Woodsmith.com* and click on the link, "SUBMIT A TIP." You can submit your tip and upload your photos for consideration.

The Winner!

Congratulations to Edward Stiles, the winner of this Porter Cable router kit. To see how you can win your own, check out the information on the left.

choosing Pine

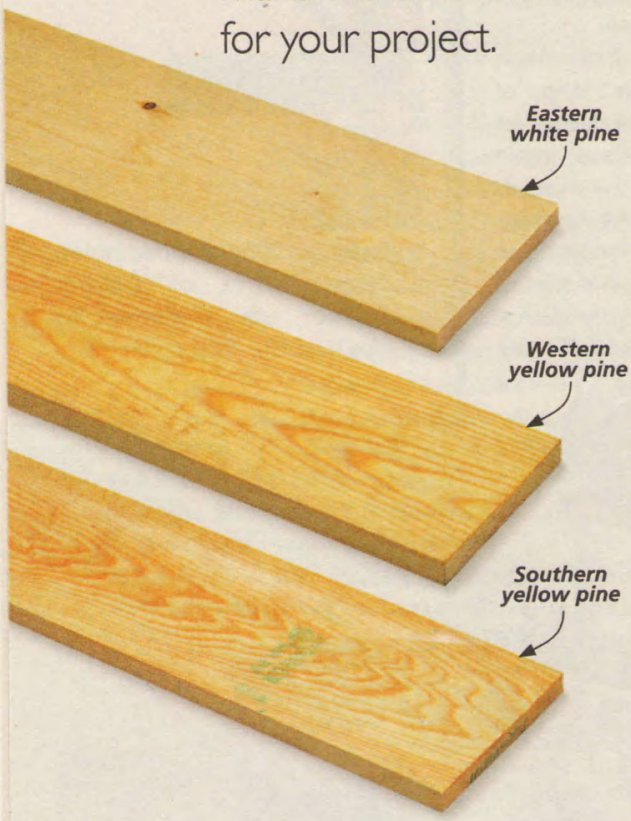
Once you know the players, you're sure to make the best choice for your project.

Pine doesn't always enjoy a good reputation among woodworkers. Its mention usually conjures up images of knotty, cupped, and warped boards with unattractive figure and color. But this can be a distorted picture. All pine is not created equal. And this can lead to a lot of confusion.

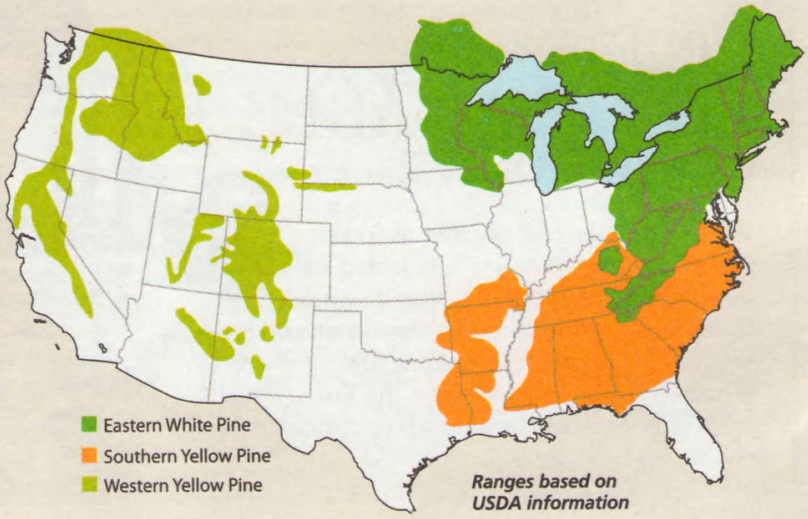
Rather than being a single species of wood like walnut or cherry, pine encompasses an entire group of woods — literally several dozen species. And within this group there is a great deal of variation in the quality, appearance, and working characteristics of the lumber. Just because some pines are not terribly desirable cabinet woods doesn't mean that you should avoid the whole group. Even the more "difficult" pines have their place when used for the right purpose.

WHICH IS WHICH? When you're considering using pine in a project, the key is to choose the type that's suitable from both an aesthetic, structural, and workability point. To do this successfully, you need to know a few specifics about the different types of pine that are commonly available.

THREE SUB-GROUPS. The 30-plus species of pine (the genus *Pinus*) that are native to North America can be divided into three subgroups based on botanical distinctions. These three groups are the true white pines, the southern yellow pines, and the western yellow pines. The wood milled and marketed from trees within each group share similar characteristics. So a general knowledge of each type's pluses and minuses will serve you well when considering pine for a project.



▲ The three sub-groups of pine offer wood that varies greatly in appearance and workability.



WHITE PINE. Let's start with my personal favorite — the white pines. When Europeans first arrived on the continent, vast forests of eastern white pine (*Pinus strobus*) stretched from Maine to Minnesota. The wood proved to be so desirable for scores of uses that virtually all of the old-growth timber is gone. But good-quality second and third growth stock can still be found. To confuse things, there are two species of true white pine that have small ranges in the West — sugar pine and Idaho pine. The wood of all three species is very similar.

Of all the pines, the white pines are the most highly prized for cabinetry. What mahogany is to the hardwoods, white pine is to the softwoods. Eastern white pine was used as both a primary and secondary wood in many pieces of colonial-era furniture.

White pine is the softest and lightest wood in the pine group. It mars and wears easily, but on the other hand it's a dream to work with either hand or power tools. The texture is very even across a board. You'll notice only minor difference between the fast-growing wood produced in spring (earlywood) and the slower-growing) laid down in summer (latewood). Furthermore, the wood has the lowest pitch content of all the pines. And to top it off, white pine is also very stable.

The color of white pine is a creamy white. The subtle figure has only moderate color contrast between the earlywood and latewood. In the past, eastern white pine was often referred to as "pumpkin pine" due the orange hue the wood takes on over time. It can be very attractive when finished naturally. However, you'll find that sugar and Idaho pine won't age to quite this degree.

SOUTHERN YELLOW PINE. A wide belt of pine growing across the Southeast provides woodworkers with the southern yellow pines. But you won't find this group to be nearly as accommodating as the white pines. In general, the southern yellow pines are some of the harder and heavier of the softwoods. It can have an overall density equal to that of many hardwoods. As it grows, it lays down very distinct layers of earlywood and latewood. These layers vary greatly in density. This can make working southern yellow pine a challenge, especially with hand tools. The wood also has a high pitch content.

This growth feature also gives southern yellow pine a very bold figure (photo above). The contrasting color between the growth layers definitely tells you the wood is pine. Like white pine, I think it looks best when finished naturally without a stain.

◄ Yellow pine is marked by great contrast in the color and density of the earlywood and latewood.

Despite its shortcomings, southern cabinetmakers have long used southern yellow pine as both a primary and secondary wood. And for many purposes, the "toughness" of this pine can be a considerable advantage.

WESTERN YELLOW PINE. Due to geography, the western yellow pines were the last to be exploited by the lumber companies and are generally the most commonly available today. More than likely, the pine boards you'll find at the local home center are western yellow pine — more specifically, ponderosa pine.

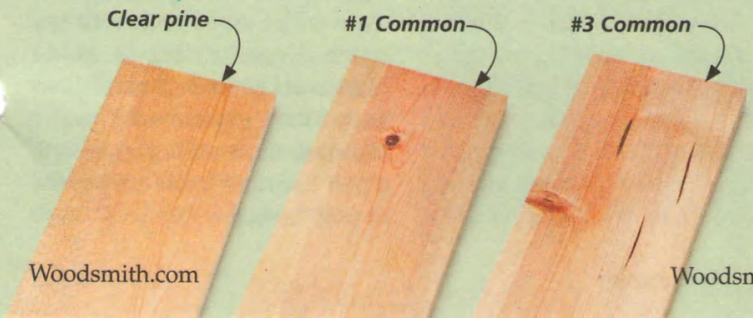
Western yellow pine occupies the middle ground between the white pines and the southern pines in both appearance and woodworker friendliness. It's slightly harder and heavier than white pine but much less so than southern pine. It has only a moderate earlywood/latewood contrast. This makes it fairly easy to work while still providing a strong pine figure. The resin content can be variable but is usually not a great nuisance.

The appearance of western pine is a more subtle version of southern pine. You'll see a distinct pine figure, but it's not overwhelming. It makes a good primary or secondary wood and can be stained or finished naturally.

As you might expect, pine availability can vary by region. But when you know what to look for and what you're getting, there won't be any surprises. W

Pine Grades

Pine has a complex grading system that can sometimes be confusing. And unlike hardwoods, when shopping for pine you're likely to have a choice between several grades — at a wide range of costs. The top grade is variously referred to as clear, finish, or C select. It should be defect free. Next comes #1 common. Here, you'll find scattered tight knots. In the utility grades — #2 and #3 common — the boards may have large knots, pith, sap pockets, and checks.

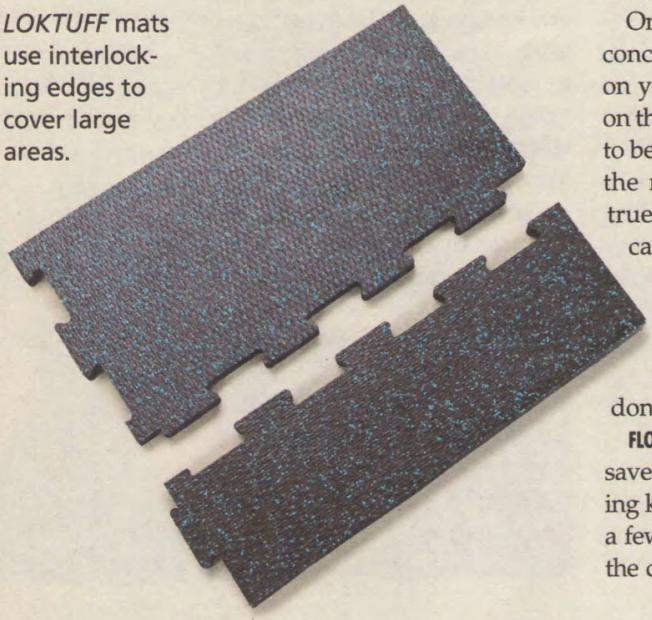


anti-fatigue Shop Mats

Save your feet, knees, and back by covering up the concrete floor in your shop. You might save a tool or two, as well.

I really look forward to spending time in the shop. But like many home workshops, mine has a concrete floor. Concrete is great for durability and cost effectiveness when building a shop, but it has a few drawbacks. Concrete is a very unforgiving surface. And a day spent working on concrete floors usually leaves me with aching knees and back pain. The net result is that my working day is too often cut short.

On top of the aches and pains, concrete can also be pretty hard on your tools. If you drop a tool on the concrete floor, you're liable to be shopping for a replacement the next day. That's especially true if you happen to knock a carbide-tipped saw blade or router bit off your bench and chip the carbide. It's even worse if the tool is a brand new hand plane. (Please, don't ask me how I know this.)

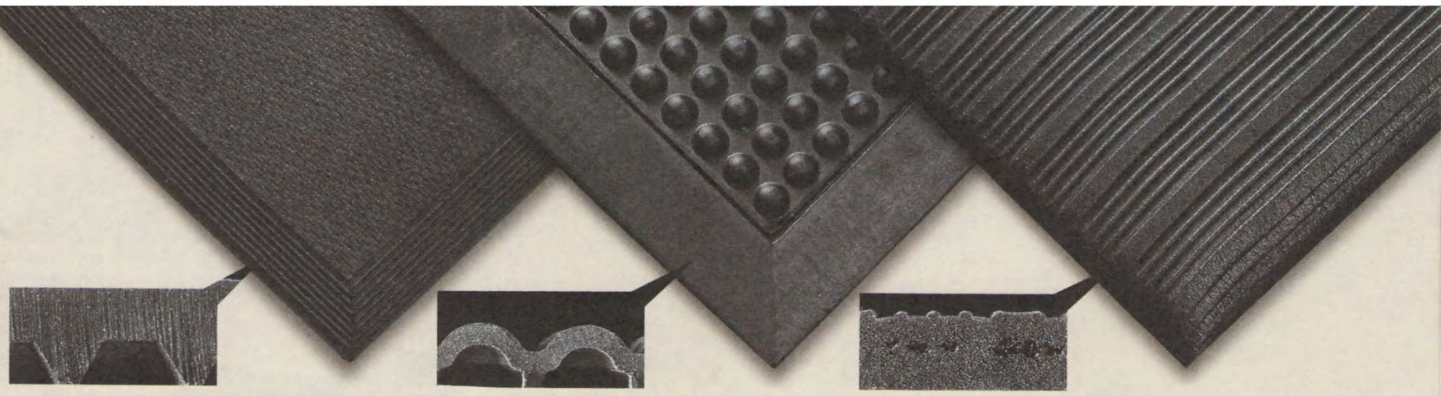


▼ *LOKTUFF* mats use interlocking edges to cover large areas.

FLOOR COVERINGS. In an effort to save my tools and relieve my aching knees and back, I investigated a few different ideas for covering the concrete. What I found was a wide array of options, with something for just about any situation. You can find out where I got these mats in Sources on page 51.

HARD RUBBER. The first option is hard rubber. The *LOKTUFF* mats in the photo at left are made from recycled tires. The biggest advantage is that hard rubber is very tough, but it still provides some help for your joints. It's hard enough to allow casters to roll, so you can cover large sections of floor, but still take advantage of having a few tools on wheels.

These interlocking mats are available in several sizes and thicknesses. And you can cut them with a utility knife to fit any space. A good strategy is to use these mats to cover most of your shop, then supplement heavy standing and working areas with softer mats, as well (box on the opposite page).



▲ This recycled rubber anti-fatigue mat is firm but comfortable.

▲ The bubble mat is durable, but also reasonably soft.

▲ Closed-cell PVC anti-fatigue mat provides the softest cushion.

ANTI-FATIGUE MATS. There are a few places in the shop where I spend the most time. For instance, the area in front of my workbench probably sees most of the foot traffic in my shop. For these spots, a softer mat is just the ticket.

Here there are plenty of options for comfort: firm, soft, or very soft. Starting with the *Cadillac* mat shown in the main photo on the opposite page or any of the three anti-fatigue mats shown above. But there's a trade-off. Generally speaking, the softer the mat, the less durable it is.

FIRM. For a firm feel, the mat in the left photo above is also made from recycled tires. The material makes the mat firm, but the open space between the solid rubber ribs gives it some spring.

SOFTER. The bubble mat in the center photo is just what the name implies. It's a series of air-filled chambers that provide the cushion. The mat is made from a combination of natural and recycled rubber material.

VERY SOFT. The anti-fatigue mat on the right uses a PVC closed-cell design for a soft, cushiony feel. Many soft mats also feature a more durable, urethane top layer.

KNEELING MAT. There are bound to be times when you need to work on something down on the floor. For those occasions, a kneeling mat is the answer. The one shown in the photo at right is a 1"-thick nitrile/PVC foam. You might not use it every day, but when you do, it's certain to be the best $20 you've ever spent.

▲ Tuning up a tool is a lot easier with a kneeling mat.

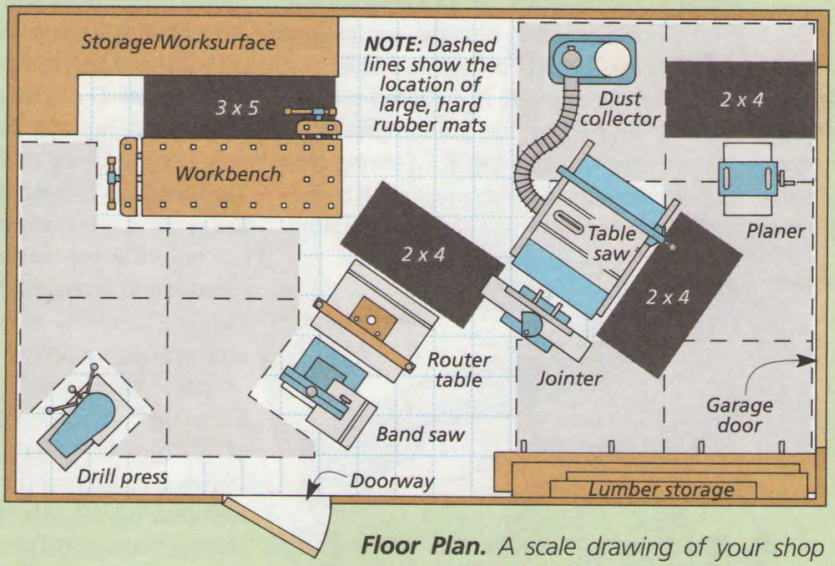
With so many options available, you're sure to find a mat that's right for you. And no matter what type you choose, you can count on less "down-time" from sore joints and aching muscles. W

How-To: Figure Out What You Need

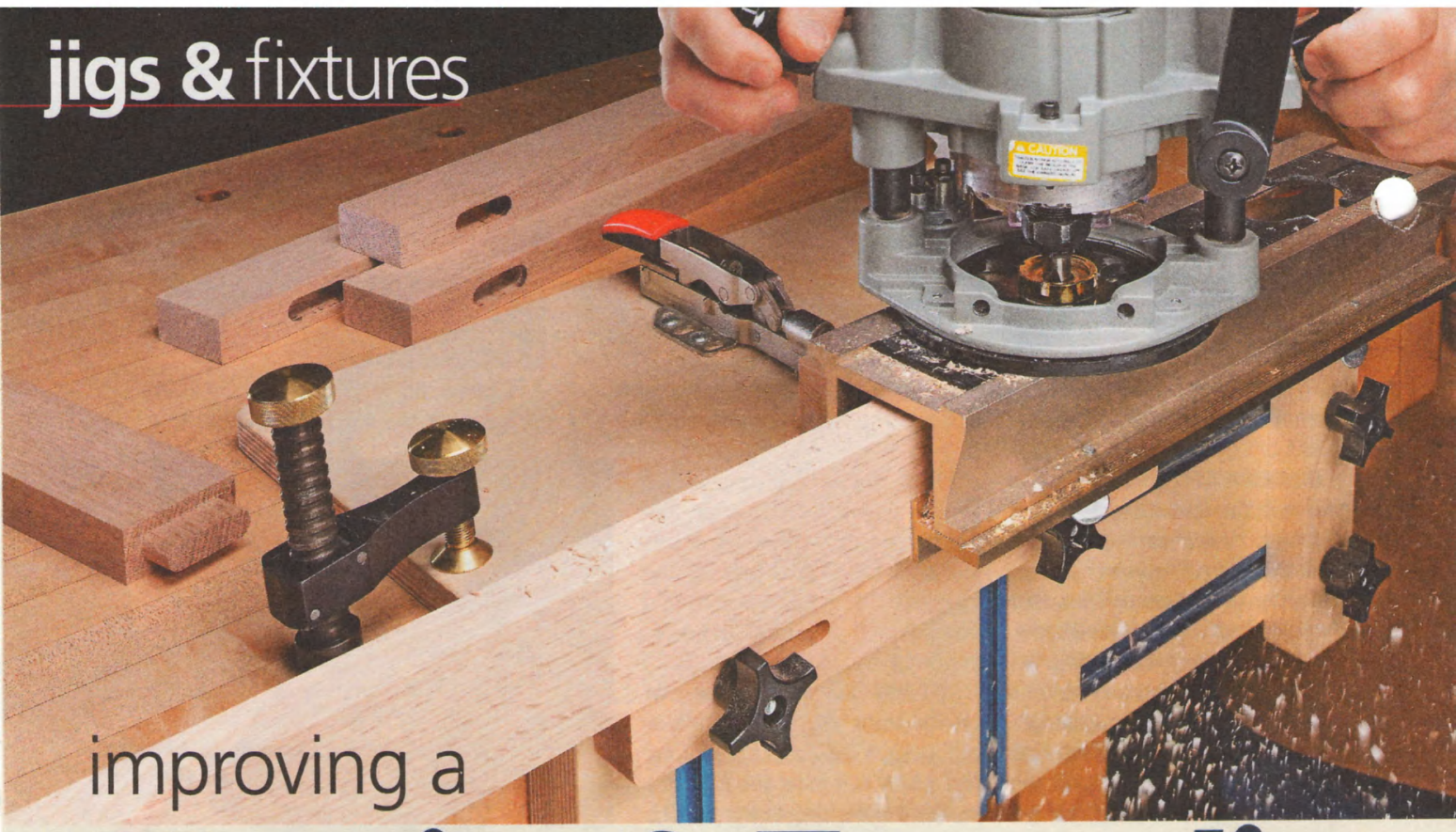
Before spending a lot of money on floor mats, it's a good idea to determine exactly what you need and where. A good place to start is with a floor plan of your shop. With a floor plan, it's easy to visualize the high-traffic areas and come up with an exact figure of the square footage you want to cover.

You'll also discover the areas you don't want to cover or need to use a firmer mat. For example, heavy tools on wheels don't roll very well on soft floor mats. But if that spot also sees a lot of foot traffic, the *LOKTUFF* recycled mats can be the perfect compromise.

Finally, the diagram will help you determine where you stand for most of your common tasks. And that's where you really want the softer mats. This can make a big difference in price if you find out you only need 40 square feet instead of 140.



Floor Plan. *A scale drawing of your shop can be a big help when selecting floor mats.*

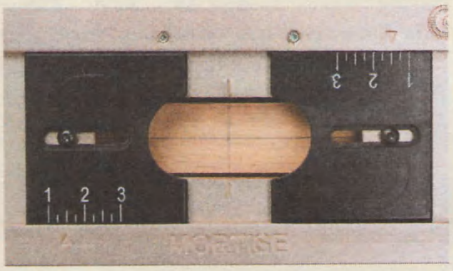


improving a Mortise & Tenon Jig

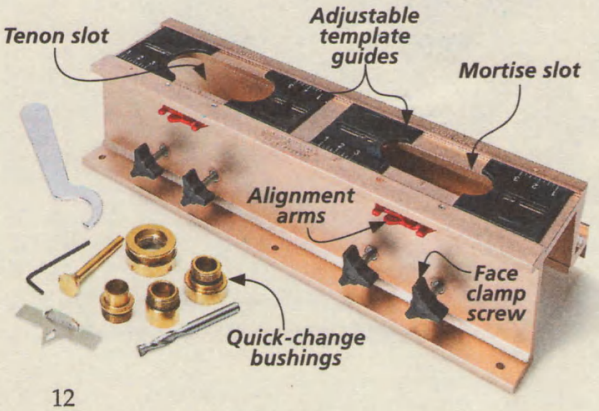
The *General E-Z Pro Mortise & Tenon Jig* won't break the bank, but can this inexpensive jig produce tight-fitting joints?

For centuries, craftsmen have relied on the strength of the mortise and tenon joint. And this joint remains as popular today as ever. There are many ways to cut mortises and tenons, but for me it's tough to beat the results you can get when using a router and a jig to guide it. A routed mortise and tenon has smooth surfaces, the first step toward a strong glue joint. So a reliable jig to rout both is a handy thing to have in the shop.

The problem is, the best jigs for these tasks cost $500-$900. Some multi-function machines even run into the thousands. That puts them out of reach for most of us. So when I heard about the *General E-Z Pro* jig with a price tag of $150, I was anxious to try it out. The question is whether the jig and your plunge router can provide you with accurate mortise and tenon joints for your projects. I recently took the jig on an extended test drive.



▲ You can make matching mortises and tenons from 1" to 3" wide by setting the adjustable template guides.



▼ The *E-Z Pro* jig includes router bushings, wrenches and a spiral bit.

At first glance, you'll notice that the main body of the jig is made of ¼"-thick extruded aluminum — plenty sturdy for the task. Also included is a set of brass "Quick-change" bushings (photo at left). These are a little different than most bushings. A two-piece collar mounts in the router baseplate, and sleeves screw into the collar.

The jig is designed to cut perfect joints by matching the settings on the two template guides on the top side of the jig, as shown in the photo above. These limit the length of cut to guarantee the mortise and tenon are the same size. Router bushings follow the templates to cut the mortise using the

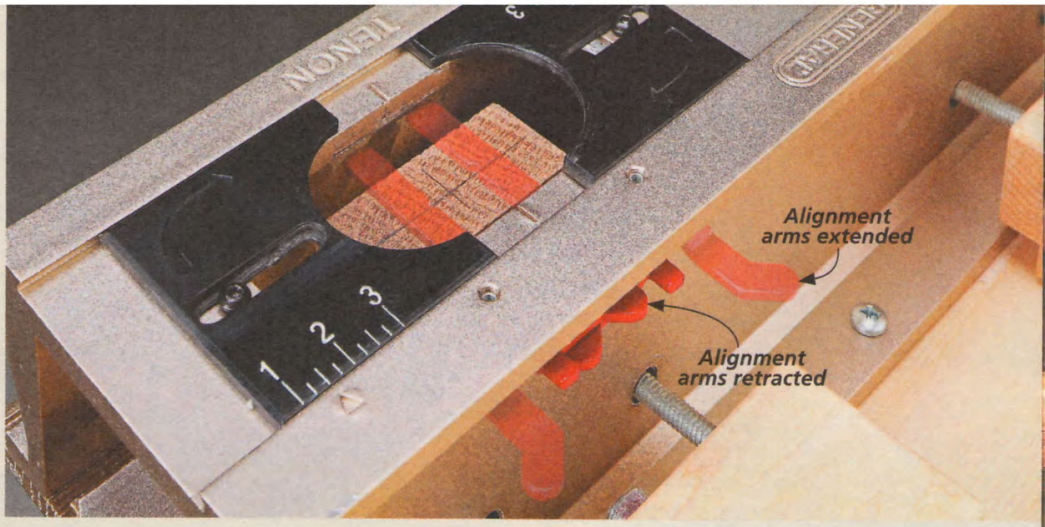
narrow slot and the tenon using the wider slot. All you need to do is loosen the set screw and align all four to the same markings on the jig as shown in the lower right photo on the opposite page.

SETTING UP THE ROUTER. Another nice accessory included with the jig is the brass centering cone. You use this when you first install the bushings to adjust the baseplate so that the bushing is perfectly centered. If it's off-center, then you won't get consistent results.

Now all that remains is to install the bit and set the depth. To do this, just add ½" to the desired depth of the mortise or length of the tenon. The ½" accounts for the height the jig holds the router above the stock.

USING THE JIG. After setting up the router, the next step is to adjust the centering fence to accommodate the thickness of the stock. For this, loosen the two thumbscrews on the bottom of the jig and move the fence to the correct setting. Note: The jig is numbered in quarter-inch increments as reference points, i.e. setting 2 equals ½"; 6 equals 1½". You can see how it works in the photo at right.

PREPARING YOUR STOCK. There's one last thing to do before you can start routing — prepare the stock for use. In addition to milling it to thickness and cutting it to final width and length, you'll need to lay out the positions of the mortises and tenons by making centerline marks on the blanks.



▲ The stamped centerline and setup markers on the jig are tough to align accurately.

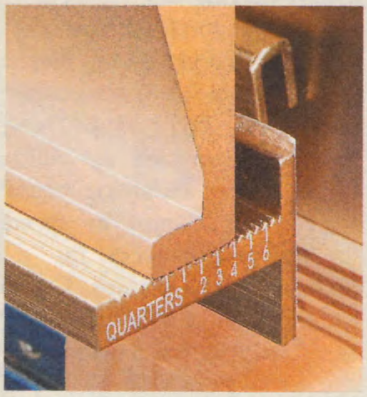
You'll use these marks to align the stock accurately in the jig.

POSITIONING THE STOCK. Now you can position the first blank in the jig. Here's where the centerline marks you made earlier come in. Move the red alignment arms into the field of the jig and lift the stock into position under the arms (photo above). Center the lines on the workpiece with the markers in the jig and on the alignment arms. Then, clamp the workpiece in position by tightening the two knobs.

The final step is to use your plunge router to rout the mortises and tenons in a series of shallow passes. Well, in theory that's how it's supposed to work, anyway.

THE BOTTOM LINE

Let me say up front that there are a few things I like about the jig. The body is solid and the techniques for making matching mortises and tenons couldn't be easier. Unfortunately, my overall assessment is that the jig is *almost* right, but not quite what I was hoping for.



◄ Set the fence to match the thickness of the stock.

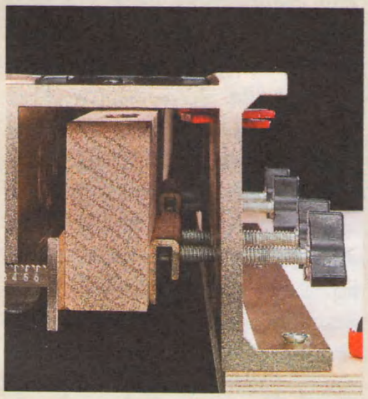
The first thing I noticed was the lack of a reliable way to square the stock in the jig. The manual says that holding the workpiece against the alignment arms will do this, but this simply doesn't work. Without a square setup, angled mortises and tenons are inevitable.

The next issue is clamping the workpiece (far left photo). The knobs are awkward to use while holding the stock in position.

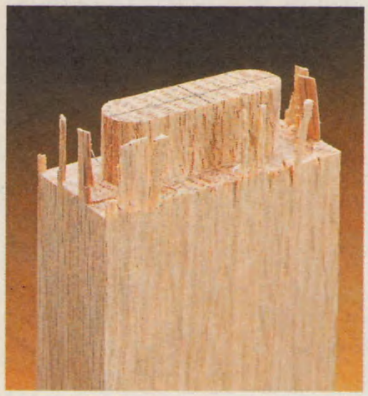
Another positioning concern involves the stamped centering marks. They're difficult to use for an accurate alignment.

Finally, too often the stock is left with a "flash" (left photo). It's a bit of wood left around the outside of a tenon. The only way to clean this up is with hand tools, and that leaves you with the possibility of ruining the clean shoulders.

But, as I said earlier, there are some things I like about the jig. And top-notch jigs cost a lot more money. While working with the jig, I couldn't help but think that it could be improved.

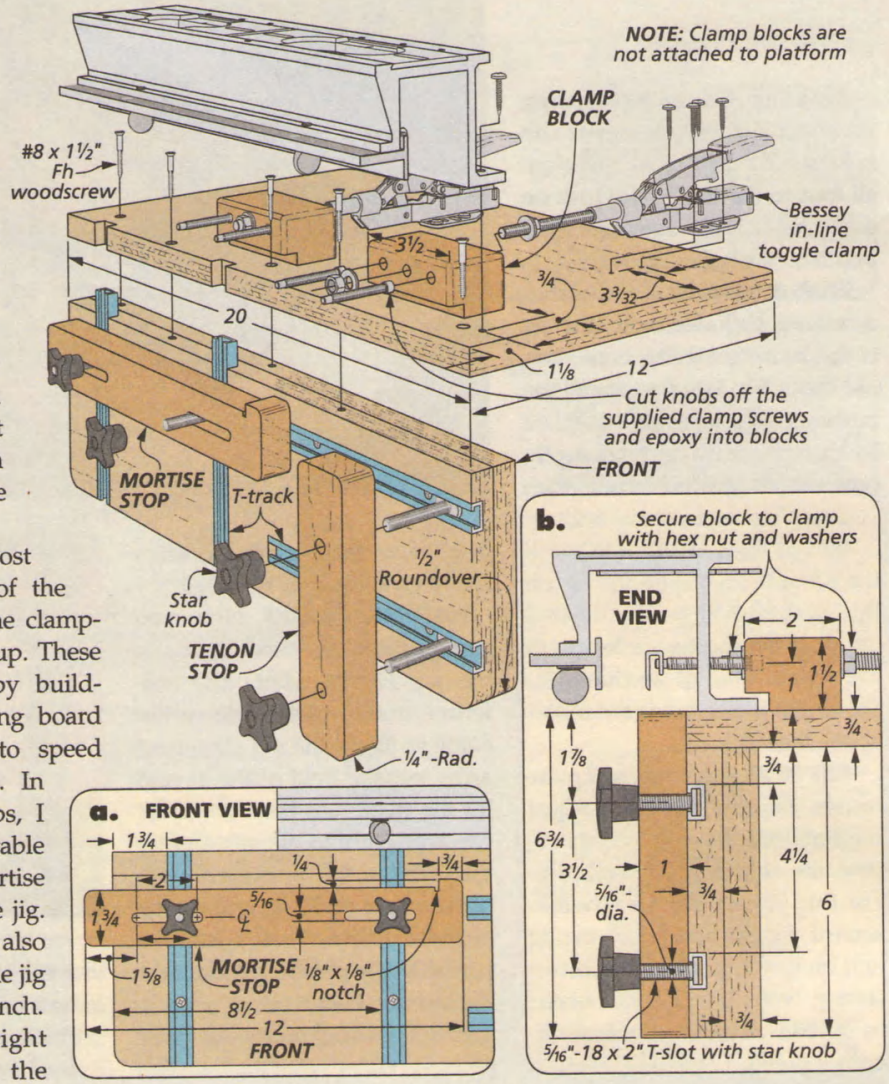


▲ The knobs are cumbersome and too slow when securing and removing a workpiece.



▲ The manual acknowledges that "flashing" can be a problem when cutting tenons.

modifying the JIG



After my first few test-runs with the jig I was convinced that there were simple ways to address the issues I'd encountered. So the next step was to design a few modifications that would turn the jig into a more solid and reliable joinery-making tool.

MOUNTING BOARD. Most of the shortcomings of the jig can be traced to the clamping and alignment setup. These are easily corrected by building a custom mounting board with toggle clamps to speed the clamping process. In addition to the clamps, I added a pair of adjustable stops for both the mortise and tenon sides of the jig. This mounting board also allows you to clamp the jig solidly to your workbench.

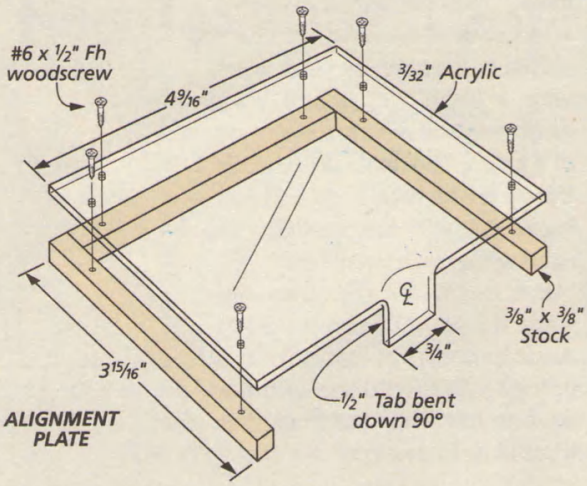
The drawings at right show the details of the mounting board and its components. I'll point out a few of the important details to consider.

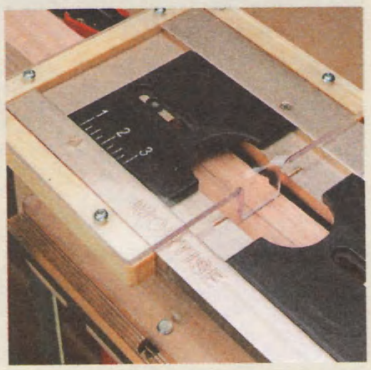
START WITH THE BASE. To get started, you'll need to build the L-shaped plywood base. As you can see, the top is a single thickness, but the front is doubled up to make it a little more rigid and to provide some clearance from the front of the bench. I attached the front to the top with glue and screws, staggering the screws as shown. After routing the dadoes and stopped grooves in the front plate, I installed standard, ¾" T-track for the flange bolts in the stops.

STOPS. There's nothing difficult about the stops either. They're simply a couple pieces of 1"-thick hardwood mounted to the T-track with flange bolts. For the mortise stop, I cut a pair of slots in the stop to make it adjustable. I also cut the edge of stop at the band saw to form a lip on one end (detail 'b'). This helps position the workpiece in the jig.

The tenon stop is simply drilled to hold the 5/16"-dia. bolts. You can use inexpensive star knobs to make the hardwood stops easily adjustable. This arrangement lets you use a square to set the stop positions of both the mortise and tenon sides of the jig for a true reference edge. (More on the setup and routing techniques later.)

CLAMPS. I made a couple changes to the jig, as well. I removed the screws from the clamping knobs and drilled out the holes in the jig. I replaced the knobs with *Bessey* in-line toggle clamps. The clamps allow you to quickly and easily position the workpieces in the jig. As the main drawing above shows, the clamps rely on clamp blocks to hold the screws





▲ A simple alignment plate takes the guesswork out of centering the workpiece.

from the original clamps in place. You can epoxy them into holes drilled in the blocks, then mount the block onto the shaft of the toggle clamp with nuts and washers for a solid connection.

STOCK ALIGNMENT PLATE. The last addition addresses the issue of the stamped centering marks on the jig. These marks are just not very helpful in achieving accurate results. Instead, I made a simple plate to help center the stock in the jig. The drawing and photo at the bottom of the facing page show you what I mean.

It's just a piece of clear acrylic with a tab mounted on a hardwood frame. After cutting the acrylic, you'll need to heat it up with a propane torch and bend the ½" tab over so it just touches the stock. This way, you can align it with the centerline marks on the workpiece for exact placement.

USING THE JIG

After you've made the modifications to the jig, you're ready to get busy routing mortises and tenons. I covered the basic setup earlier, so now I'll focus on the differences and give you some guidance for getting good results from the modified jig.

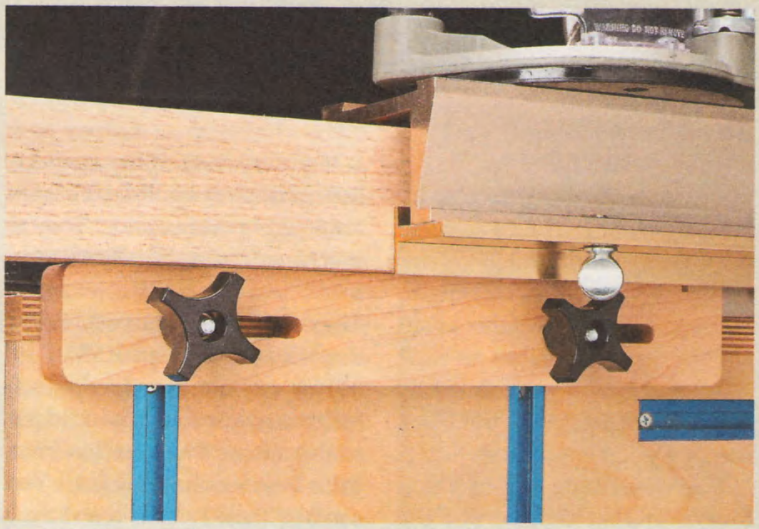
JIG SETUP. The basic techniques for setting up the router and milling your stock are the same.

▲ I used conventional router bushings (left) as well as those provided with the jig.

But you'll want to be sure to mill a few extra pieces to the thickness of your project parts. You'll need these for making test cuts as you dial in the settings.

Swing the red alignment arms into position and hold the workpiece snug under them while you move the stop in place and lightly tighten the knobs. Now remove the workpiece and use a square to set the final stop position.

With the stop set, hold the workpiece against it and lock it in place using the toggle clamp. Use the alignment plate to double-check the position and make sure the workpiece is centered front-to-back and side-to-side. You can make small adjustments simply by opening the toggle clamp slightly and moving the stock.



▲ In addition to holding the stock at the correct height, the mortise stop also allows you to move it right or left to perfectly position the workpiece by aligning your layout marks.

▲ The tenon stop provides a reference edge for positioning the tenon stock and making sure it's square to the jig and router.

ROUTER SETUP. Once you've got the stock properly positioned, the next step is to install the correct router bit and bushing. With a little experimentation you'll find that a combination of different bit diameters and router bushings will allow you to make just about any size joint.

A ¼"-dia. spiral bit is included with the jig, but you'll need ½" and ⅜" bits as well to take full advantage of the jig. I also opted to use a standard set of router bushings for cutting tenons. This way, you'll have more flexibility to cut perfect tenons. For example, I found that a ½" bit in a ⅝"-O.D. collar worked well for making a first pass to remove the material that a smaller diameter bit would miss. This helped solve the flashing problem. A second pass with a ¾" bushing left a ⅜"-thick tenon.

The large bushing included with the jig remains the best answer for cutting mortises, however. It fits that slot well for a centered cut.

It all sounds harder to do than it really is. I've found that a few minutes of planning and experimenting result in top-notch joints. All in all, the upgrades made this jig an inexpensive way to make first-rate joinery. W

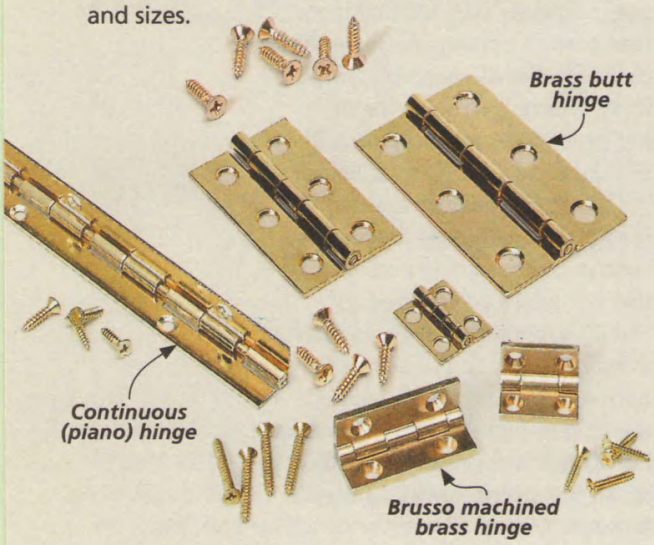
small box Hinges

As a woodworker, making lidded boxes can start out as a great way to use up leftover wood. For some of us, it can even become an obsession. Either way, chances are that most of us will make at least a few small boxes in our woodworking careers.

Sometimes, however, it's easy to get caught up in the woodworking and forget about the other details, like the hinges. That often results in some last-minute scrambling to find something that will work rather than designing the project with the best hardware in mind. This approach can prevent a good piece of woodworking from becoming a great project.

While trying out ideas for some new box designs, I picked up a few of the more commonly used hinges. Many are available in hardware stores and all can be found at the major online retailers (see Sources on page 51). Hopefully, they'll give you some ideas to create the right look for your next box project.

▼ Butt hinges come in a wide range of shapes and sizes.



BUTT HINGE

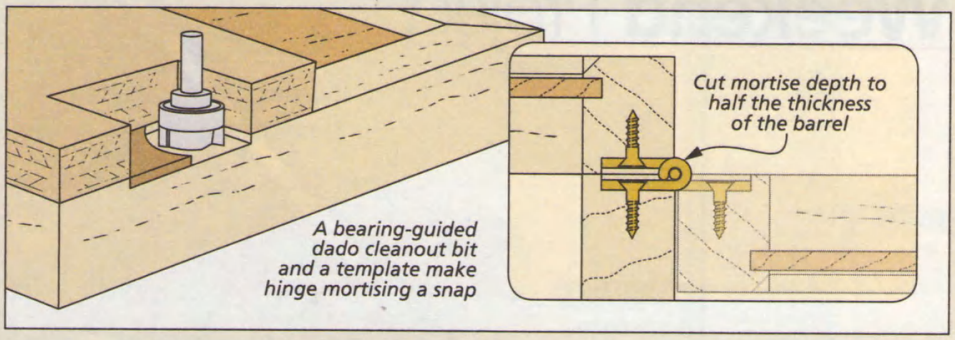
First up is the hinge we're all familiar with. Butt hinges come in all sizes — from small box size all the way up to door hinges. You can find butt hinges available in several finishes as well. Brass and nickel are commonly used for box building, but black can be a good choice too.

The nice thing about these hinges is that they're not too expensive. Most are made of sheet metal stock, stamped and rolled around the hinge pin.

If you're willing to spend a little more money, *Brusso* hinges are a high-quality option. They're machined from bar stock and made to very tight tolerances. They also offer stopped hinges that hold the lid open at 95°.

The continuous (or piano) hinge is also widely used. I turn to this hinge when the load is a little heavier than normal. You can buy these hinges in a variety of sizes, but you'll spend less by buying a large size and cutting off the lengths you need.

You'll want to mortise butt hinges for the best look and to allow both halves of the box to fit together without a gap. You can do that by hand, or with a router and jig (as shown in the drawing at right). When you set the depth of cut, it needs to be half the thickness of the barrel (not just the thickness of the leaf) to get a good fit.



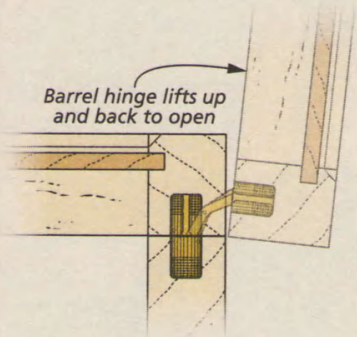
BARREL HINGE

Although the barrel hinge is a little bit odd-looking, it's perfect for small boxes. To install a barrel hinge all you need to do is drill matching holes in the box and lid and then press the hinge in place.

One thing to keep in mind when working with barrel hinges is that they're usually available only in metric sizes. I use 10mm hinges for ½" stock, and 14mm for ¾". So you'll need to buy the corresponding size drill bit, as well.

The photo below shows an easy way to mark the location of the holes for the hinges. Then head to the drill press to drill the holes.

BOTTOM LINE. Whatever hinges you choose, it's a good idea to have them on hand before you begin building your box. This way, you can work out the mounting and placement details. You can take your box projects to the next level by taking the time to select the right hinge. W

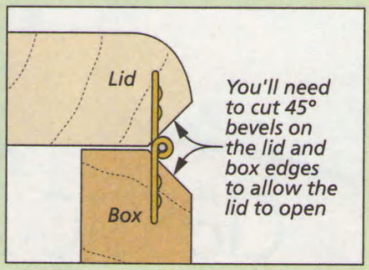


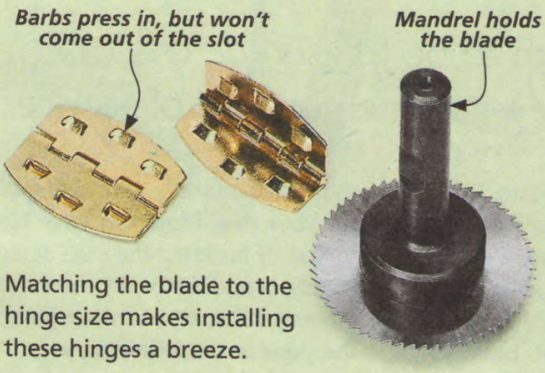
▼ Clamp the lid and box together to mark the location for the barrel hinges.

Worth a Look: Barbed Hinge

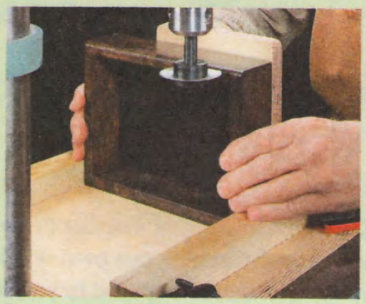
If you're looking for an inexpensive hinge that's also easy to install, then you might want to consider a barbed hinge. This press-fit hinge is available in several sizes. To install the hinges, you need a narrow-kerf blade (like the one shown below) to cut matching slots in the box and lid. Then the hinge is pressed in place. The barbs on the leaves prevent the hinge from coming out of the slots.

▲ A barbed hinge presents a tidy, professional appearance when properly installed.

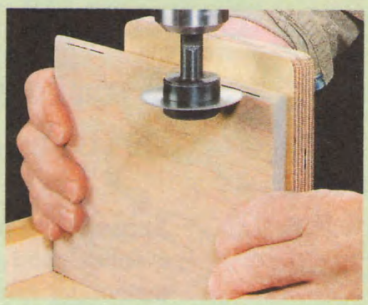




► Matching the blade to the hinge size makes installing these hinges a breeze.



▲ A pair of guides on the drill press table allow you to align the hinge position.



▲ Use a backer board with the guide rails to support the lid while cutting the slots.

classic Flag Case

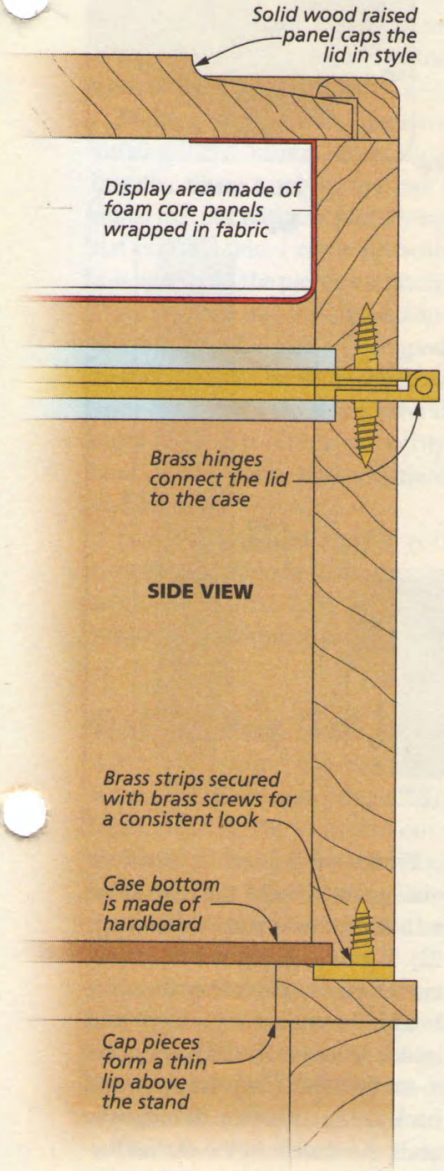
A military-issued flag is an heirloom to be treasured. This case serves as a worthy resting place for a commemoration of service.

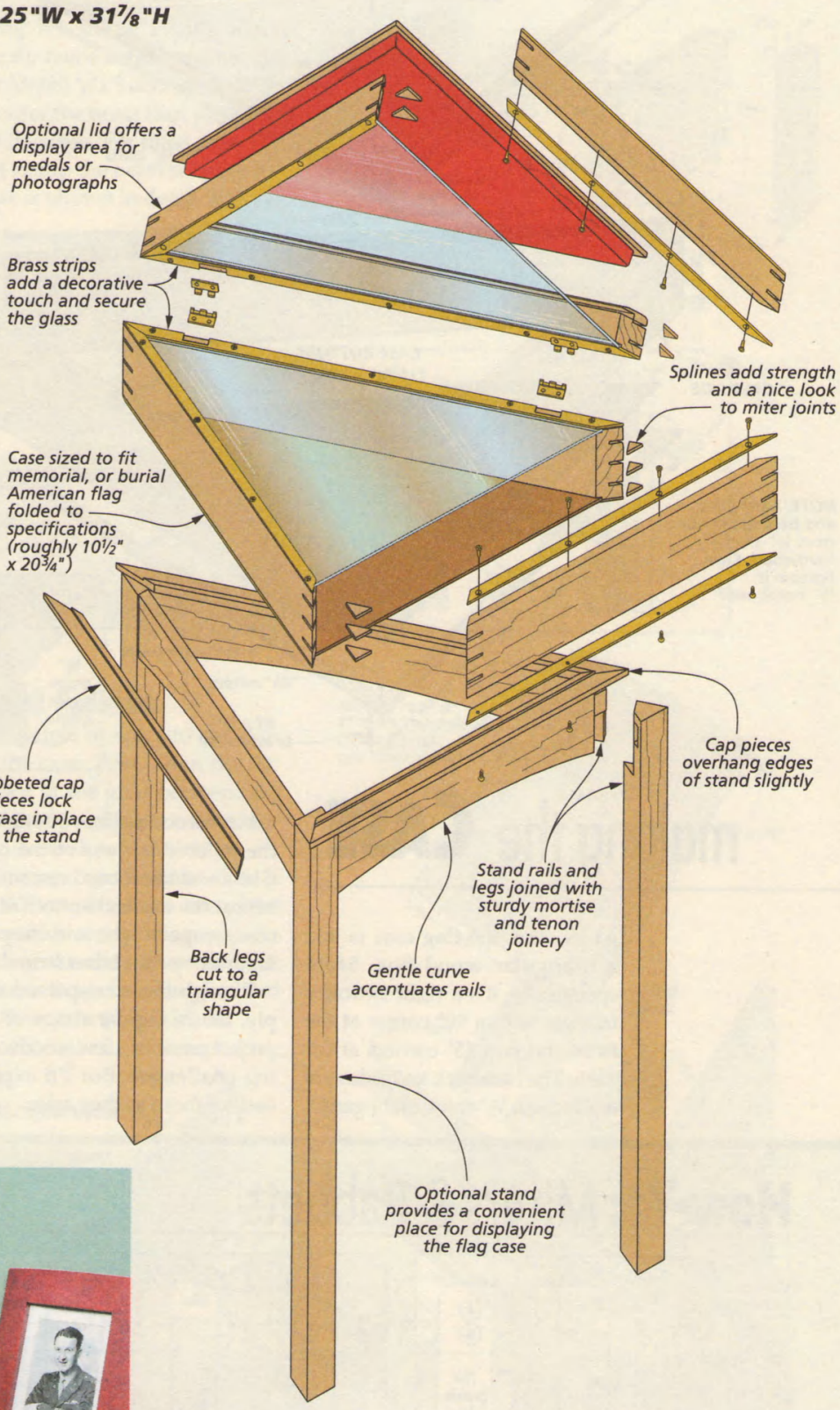
According to military tradition, a solid-wood case is a fitting method for displaying an American flag. And whether the case is meant to preserve a commemoration of service or simply serve as a display of patriotism, building your own will make it even more special to you or your loved ones.

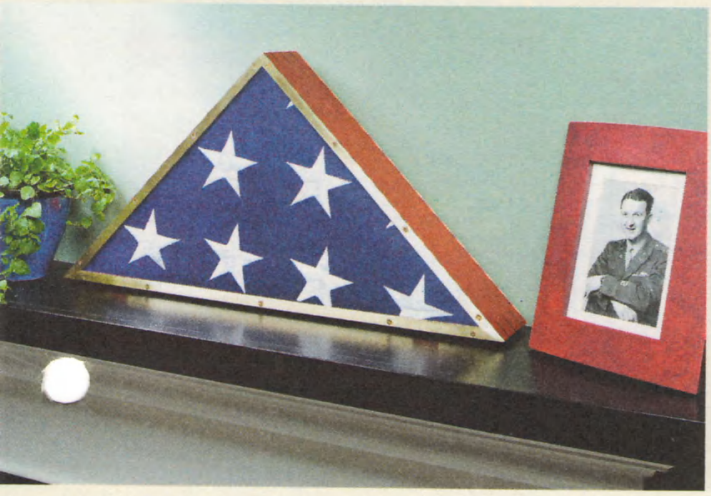
Constructed of solid mahogany and highlighted by splined, mitered corners and brass strips, this case is certainly a suitable spot for your flag. Plus, you have the option of building the case alone (right), or adding the lid and stand (above). I'll walk you through all the steps on the following pages.

CONSTRUCTION DETAILS

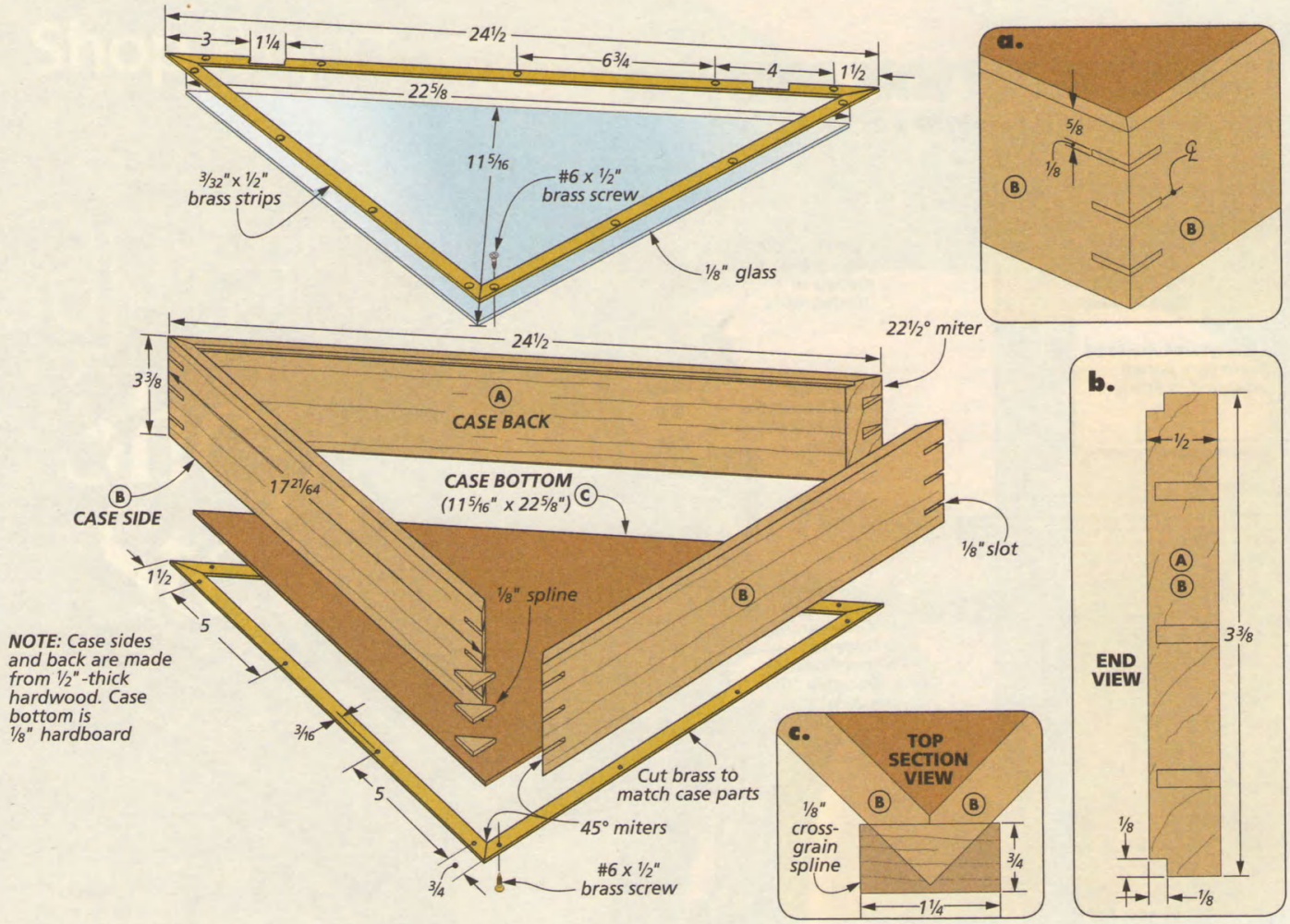
OVERALL DIMENSIONS: 12⅝"D x 25"W x 31⅞"H







◄ Built on its own, the case looks great on a display shelf or fireplace mantel.



making the CASE

At its core, the flag case is just a triangular wood box. More specifically, it's a right isosceles triangle with a 90° corner at the front and two 45° corners at the back. The case back and sides are made from ½"-thick mahogany.

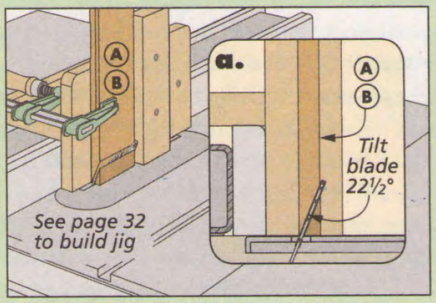
Hardwood splines strengthen the mitered corners of the case. Glass and hardboard rest in rabbets at the top and bottom of the case, respectively, and they are secured by thin brass strips.

Though the concepts are simple, the triangular shape of this project presents a few woodworking challenges. But I'll explain each of those as they arise.

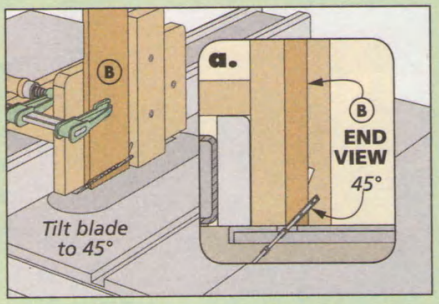
First, you'll need to decide if you want to build the case alone or both the case and lid (see page 22). If you're going to build both, cut the mating parts from the same boards to ensure a good fit and match. Then set the lid parts aside.

ADD THE MITERS. Once the sides and back are cut, it's time to miter the ends. As shown in the main illustration, the front ends of the sides

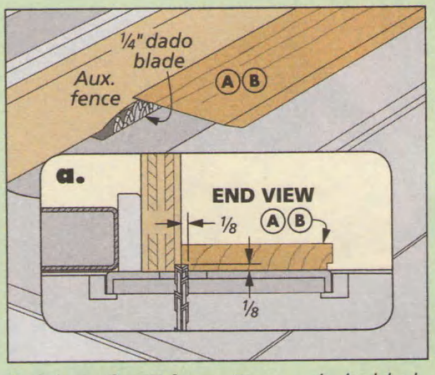
How-To: Miters & Rabbets



Cut 22½° Miters. *Clamp a case part to the jig on end, tilt the blade 22½°, and pass the workpiece through the blade.*



Cut 45° Miters. *For the 45° miters, tilt the blade to 45°, reposition the rip fence, and repeat the cut.*



Rabbet the Edges. *Bury a dado blade in an auxiliary fence to rabbet the long inside edges of the sides and back.*

have 45° miters, but the sides meet the back with 22½° miters.

A table saw blade won't tilt far enough to cut these miters with the workpiece flat on the table. So I made a table saw jig to hold the pieces on end (refer to Shop Notebook, page 32). After using the jig to cut the 22½° miters, you can use it for the 45° miters, as well. For guidance on both cuts, see the box at the bottom of the opposite page.

RABBET THE EDGES. Next the edges of all three case parts are rabbeted to receive the hardboard bottom and glass top as shown in the bottom right drawing on page 20.

ASSEMBLY & SLOTS. At this point, you can assemble the case by gluing the mitered corners together. The lower left drawing shows you how. Once the glue dries, the next step is to cut slots in each corner to hold splines. This is accomplished with the jig you see in the drawings below. For full details on building the jig, see Shop Notebook on page 32.

After marking the slot locations on the case corners, align a mark from the 90° corner with the kerf cut on the sled and clamp the case in place. Now pass it through the blade (middle left drawing below). Repeat for each slot on this corner.

For the 45° corners, lean the case side against the back of the cradle with the back facing forward for each cut (middle right drawing).

ADD THE SPLINES. With the slots cut, all that's left is to rip thin strips for the splines to fit them (detail 'c,' opposite page). Then install splines as shown in the right drawing below. At this point, you can gently sand the corners of the case and apply the finish.

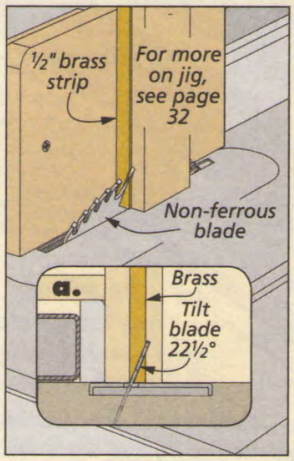
BOTTOM & GLASS. The case has a triangular-shaped bottom made from ⅛" hardboard. You can cut this to size now. While you're at it, it might be a good idea to make a second one to take to a glass shop and have them cut a glass panel to match. (If you're making the lid, you'll need two glass panels the exact same size.)

BRASS STRIPS. The hardboard bottom and glass top are secured by brass strips. These strips are mitered, drilled and countersunk for screws, and then installed on the edges of the case parts.

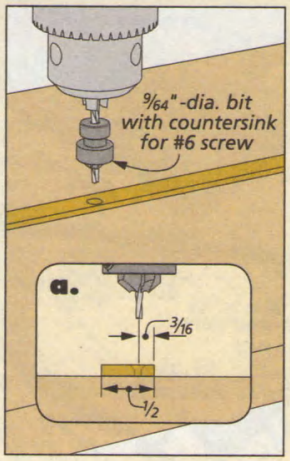
If you're adding a lid, you'll also need to add hinges to the top edge of the case back. This requires notching the back brass strip.

The illustrations above show you how to miter, drill, and notch the brass strips. Before attaching the strips, sand them with 220-grit sandpaper for a brushed finish. Then test-fit the strips and mark hole locations on the wood edges. Finish up by attaching the brass strips and hinges with screws.

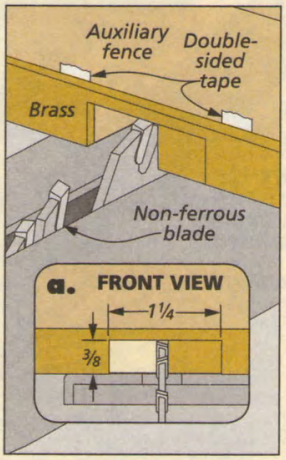
Shop Tip: Cutting & Drilling Brass



Miter Strips. *Tilt the blade, and use a jig to cut the strips positioned on end.*

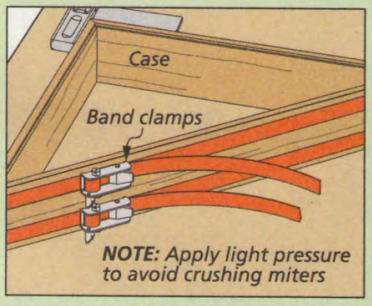


Countersink. *Use a drill press to create the off-center countersunk holes.*

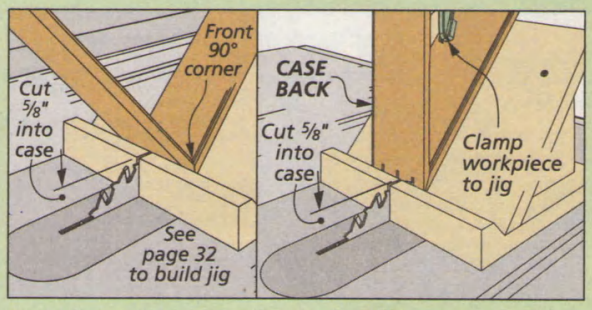


Hinge Notches. *Support the strip with an auxiliary fence as you cut the notch.*

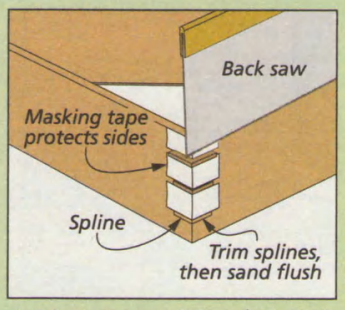
Assembly & Splined Miters



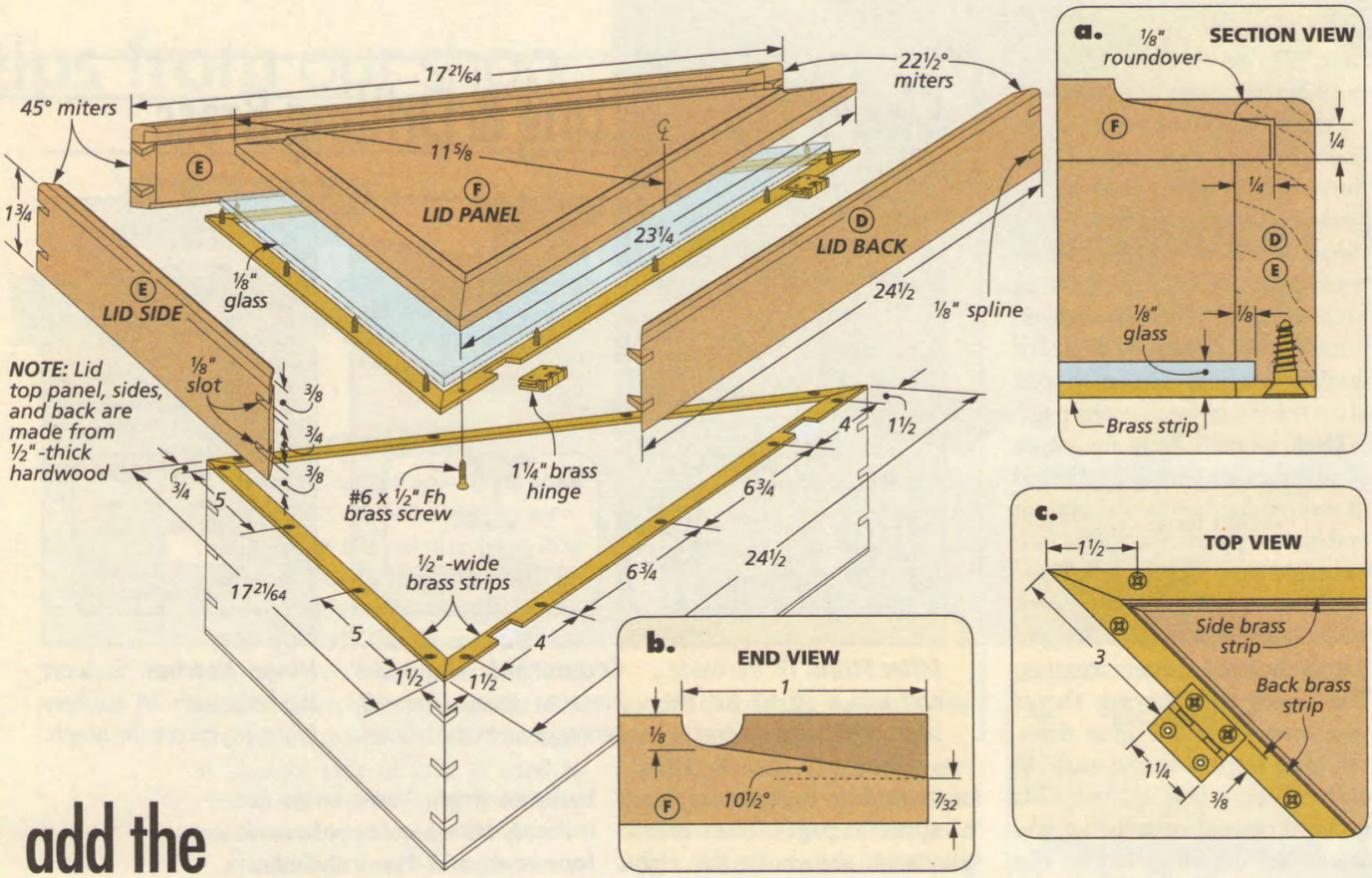
Assemble the Case. *Apply glue to the miter joints, then use band clamps to draw them together.*



Cut Slots. *To cut the slots in the 90° corner, seat it in the jig, and pass it through the blade (left). For the 45° corners, have the back facing forward in the jig (right).*



Add Splines. *Glue ⅛"-thick splines into the slots. Trim them flush, and sand them smooth.*



add the CASE LID

Now that you've successfully completed the case, you should find making the matching lid fairly straightforward. That's because its construction is similar. The joinery at the lid corners is nearly identical to the case. And a glass panel is held in place with brass strips on the inside of the lid.

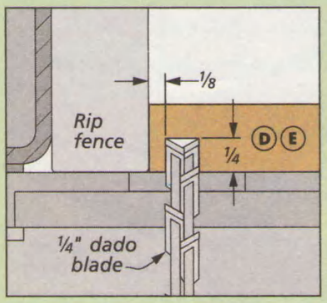
The differences are found at the top of the lid. Here, a solid-wood raised panel fits in a groove. And underneath that panel, there is an area for displaying medals, patches, and other items. It's made up of layers of foam core wrapped in fabric.

START WITH THE SIDES. After cutting the lid parts to size, you can miter them and rabbet the bottom edge of each part following the same procedure used for the case (see the box on page 20). A groove near the top edge of each part accepts the raised panel. And a slight roundover on the top of the lid parts helps to soften the edges. You can see how to make these cuts in the drawings on the left below.

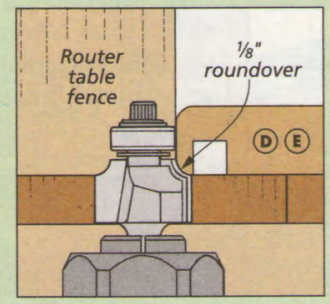
RAISED PANEL. At this point, you can turn your attention to the solid-wood raised panel that fits in the groove in the lid. Start by gluing up a panel slightly wider than the top's final dimensions.

Once the glue dries, sand the panel smooth. Then carefully lay out the final triangular shape, and trim the panel to size using

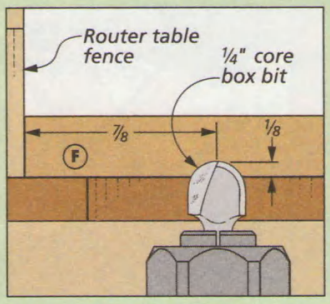
How-To: Add a Raised Panel



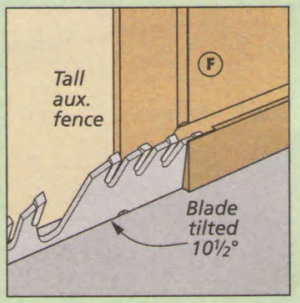
Cut Groove. *Make a groove in the lid sides and back using a dado blade at the table saw.*



Rout a Roundover. *Soften the top edges of the parts by routing a roundover on them.*



Raised Profile. *Establish the shoulder of the panel profile with a core box bit.*



Bevel Cut. *Tilt the blade, and cut along the three sides to finish the profile.*

your table saw's miter gauge with an auxiliary fence.

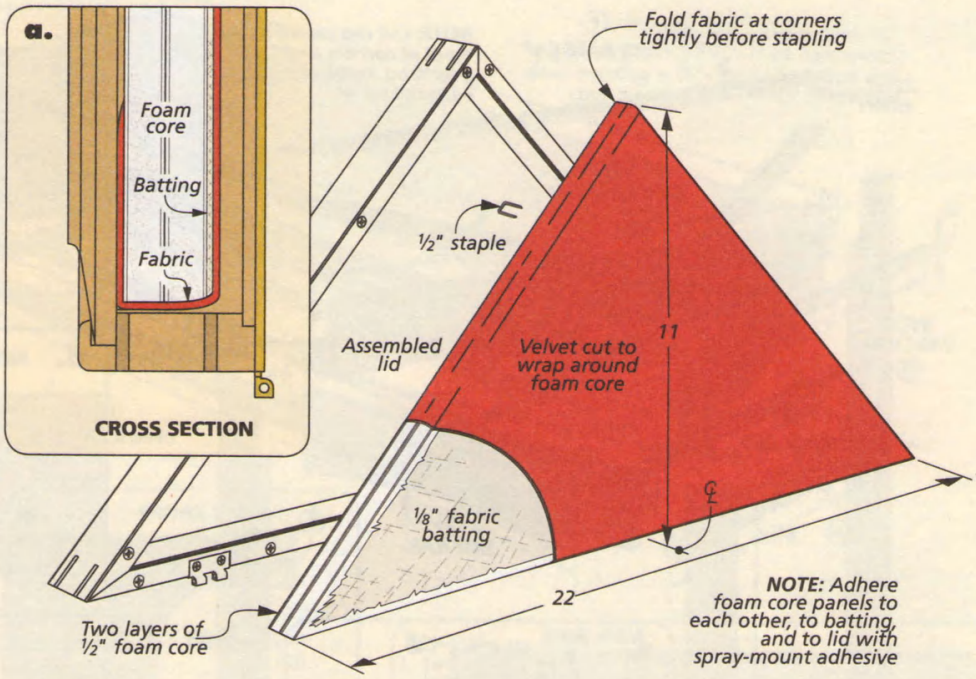
Now you can create the raised portion of the panel. You can do this with a two-step method at the router table and table saw, as shown in the How-To box on the opposite page. At the table saw, sneak up on the thickness, and test the fit of the panel in the groove in the lid parts until you achieve a smooth, friction fit. Then sand the profile smooth, and apply finish to the top.

ASSEMBLE THE LID. The lid assembly is familiar territory. The only difference between this glue-up and the case is that the top panel should be in place as you glue the lid together. I found this actually helps with the glue-up. The panel helps keep the parts aligned as you tighten the clamps.

Apply glue to the mitered corners of the lid, and also put a bead of glue at the center of the two short sides of the top panel where it will rest inside the groove. Then use band clamps to hold the assembly while the glue dries.

ADD THE SPLINES. Just as with the case, the lid has splines added to the slots at the corners. The only difference is that the lid has two splines at each corner while the case has three.

You can use the same procedure as before to cut the slots and add the splines. Now sand the lid corners to soften them, and apply finish to the lid.



DISPLAY AREA. On the inside of the lid panel, I created a display board for medals, patches, and other memorabilia. The board is made up of two layers of foam core panels that are cut to a triangular shape with a utility knife. Then, a piece of batting, also cut into a triangle, is applied to the outer face, and it all gets wrapped in velvet.

The velvet is attached to the backside of the foam core with staples. The assembly is then mounted to the lid panel with spray-mount adhesive. You can see how it goes together in the illustration above.

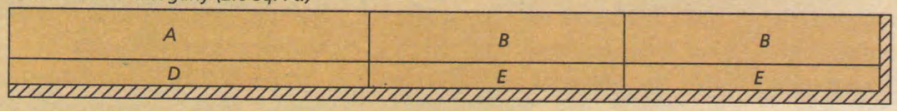
ENCLOSE THE LID. Now all that's left is to add the glass panel and brass strips to the bottom of the lid. Here again, the process for this is the same as it is on the case: Just miter the strips, countersink holes in them for screws, and notch the back brass strip to accept hinges (see the box at the top of page 21). Then fit the strips to the case, transfer the holes to the edges of the lid sides, and secure the strips and hinges with brass screws.

Materials, Supplies & Cutting Diagram

A	Case Back (1)	½ x 3⅜ - 24½
B	Case Sides (2)	½ x 3⅜ - 17 21/64
C	Case Bottom (1)	⅛ hdbd. - 11 5/16 x 22⅝
D	Lid Back (1)	½ x 1¾ - 24½
E	Lid Sides (2)	½ x 1¾ - 17 21/64
F	Lid Top Panel (1)	½ x 11⅝ - 23¼

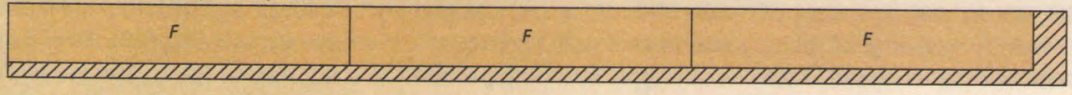
- (6) 3/32" x ½" Brass Strips (36" long)
- (2) ⅛" Glass Panes (11 5/16" x 22⅝")
- (1) ½" Foam Core Panel (24" x 48")
- (1 yd.) Red Velvet Fabric
- (2) 1¼" x ½" Brass Hinges w/Screws
- (26) #6 x ½" Fh Brass Woodscrews

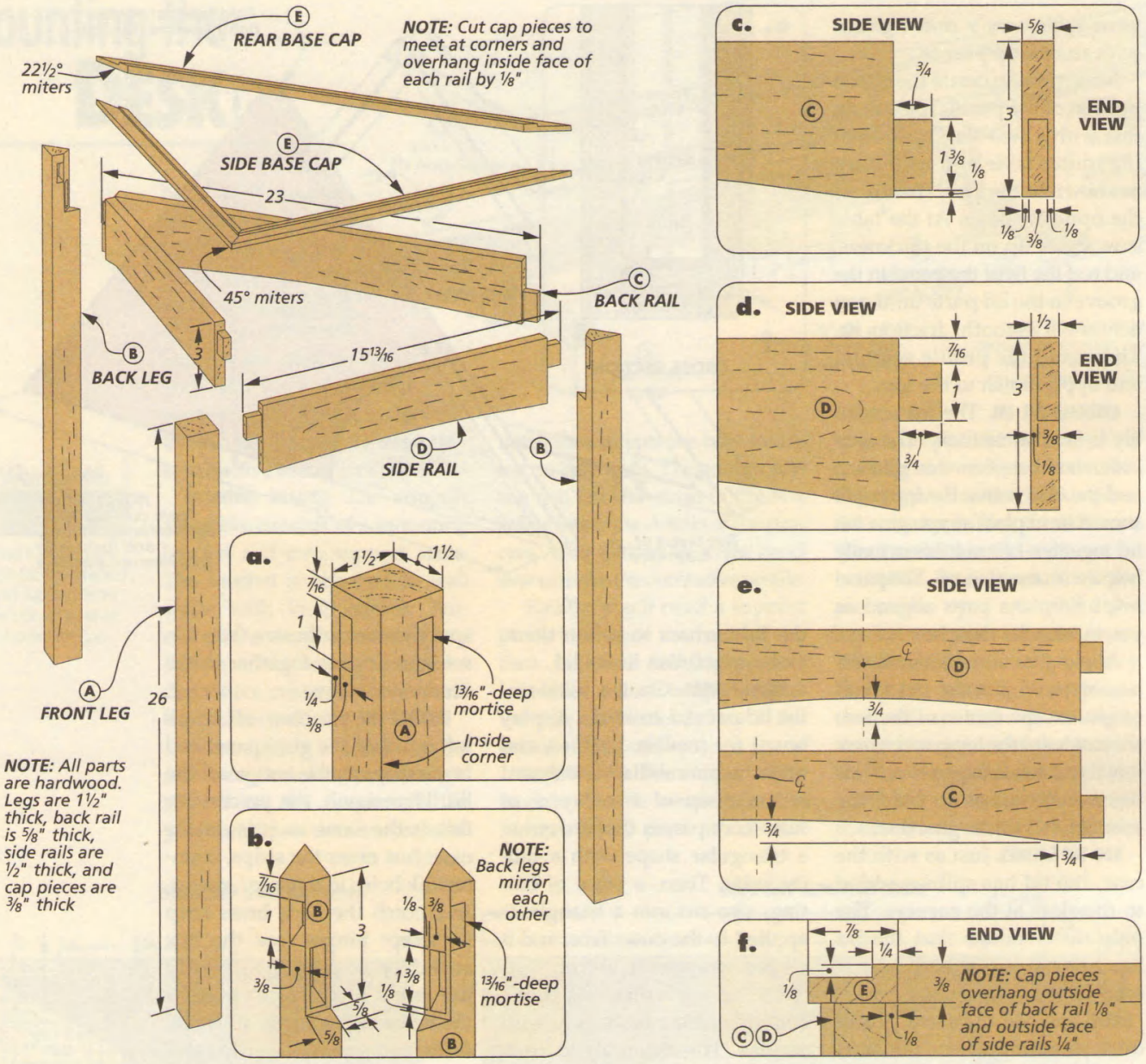
½" x 6" - 60" Mahogany (2.6 Sq. Ft.)



ALSO NEEDED: One 24" x 24" sheet ⅛" hardboard

½" x 5" - 72" Mahogany (2.5 Sq. Ft.)





create the CASE STAND

If you're looking for a prominent way to display the flag case, this companion stand is the perfect option. It features rock-solid mortise and tenon joinery between the rails and the legs.

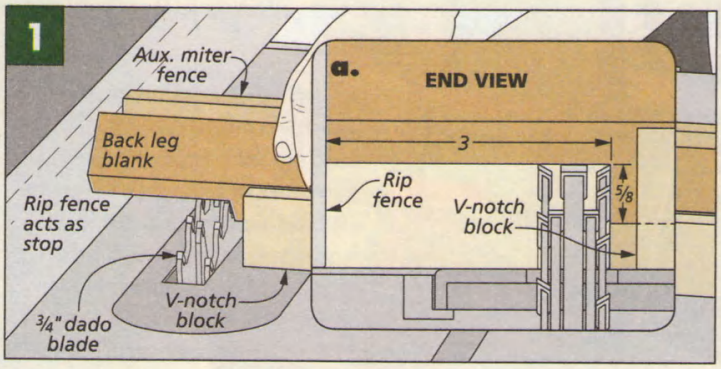
START WITH THE LEGS. Speaking of those legs, they're a good place to start building the stand. Each one begins as a 1½" square blank. The back legs are eventually cut into a triangular shape. But for now, simply cut all three leg blanks the same size, and set two aside for the back legs. On the front leg, lay out two mortises as shown in detail 'a.' Drill out the waste, and clean up the mortises with a chisel.

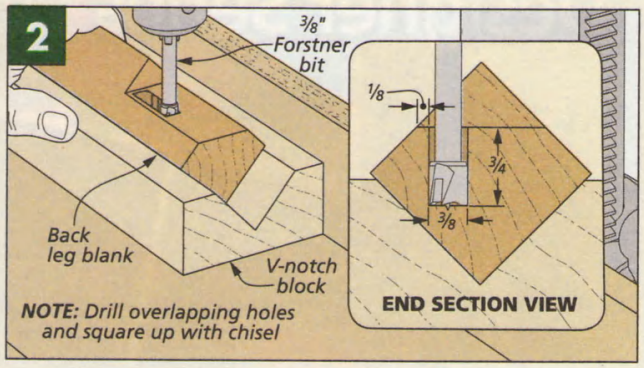
CREATE BACK LEGS. Along with being triangular in shape, each of the back legs also has a notch and two mortises (detail 'b'). Note that the back legs also mirror one another. You'll need to take that into account as you lay out and cut each back leg.

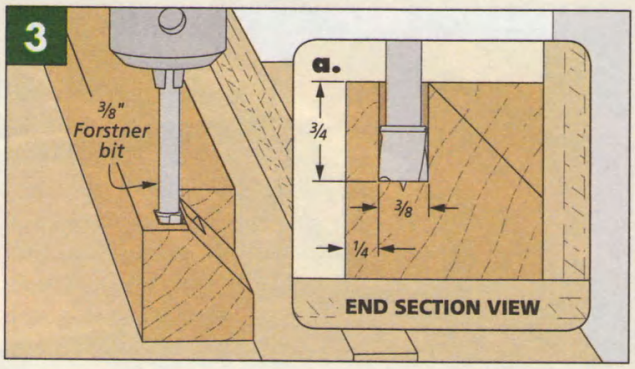
A simple four-step process for making these legs is outlined on the opposite page. You'll want to start by cutting a V-shaped groove in a 2x4 block to serve as a support for the leg blank. Then, nestle one corner of the leg blank into the groove, and create the notch at the top of each leg as shown in Figure 1.

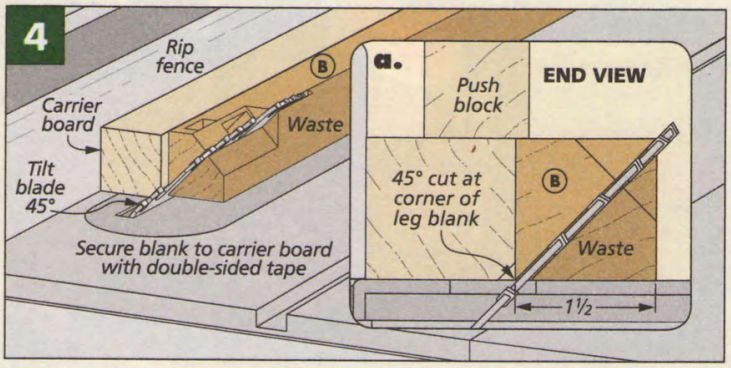
Next, rotate the leg blank 180° in the grooved block, so the notch is facing up. Lay out the mortise location, and cut it at the drill press as shown in Figure 2.

To make the second mortise, remove the leg blank from the V-block and set it flat on the drill press table (Figure 3). After drilling out the waste, use a chisel to clean up the two mortises.









Now all that's left is to cut the leg blanks to their final triangular shape. Figure 4 shows you how. Once that's done, soften the sharp edges and the bottom of each leg with sandpaper.

CREATE THE RAILS. With the legs complete, turn your attention to the rails. They have a tenon on each end and a gentle arc on the bottom for an elegant look. As you can see in the details on the opposite page, the tenons on the side rails are different from the tenons on the back rail.

After cutting the rails to size, you can make the tenons at the table saw with a few passes over a dado blade. Now lay out the arcs on the bottom edges of the rails and cut them at the band saw.

ASSEMBLE THE STAND. Thanks to the mortise and tenon joints, assembling the stand is simple. Apply glue to the joints, and draw the pieces together with band clamps to protect the fragile corners.

CAP PIECES. The only parts left to add are three cap pieces. As shown in detail 'f' on the opposite page, each one is a thin strip with a rabbet on the top. It's safer to make these strips by cutting the rabbet on a wide board that has been planed to 3/8" thick. To do this, partially bury a dado blade in an auxiliary fence attached to your rip fence, and cut the rabbet. Then rip each strip to its final width.

Now cut the miters where the cap pieces meet at the corners. (They should each overhang the inside face of the rail by 1/8".) You can use the jig shown in Shop Notebook on page 32 to hold the strips as you cut them.

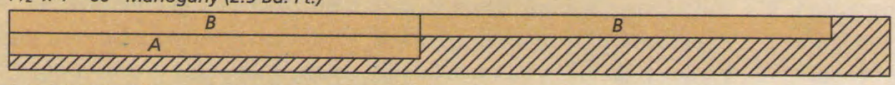
Once the strips are complete, test their fit on the stand. Then glue and clamp them in place. When the glue dries, you can apply a finish to the stand.

In the end, you'll have a beautiful, handmade project that will no doubt serve as a fitting commemoration of your or a loved one's service in the military. W

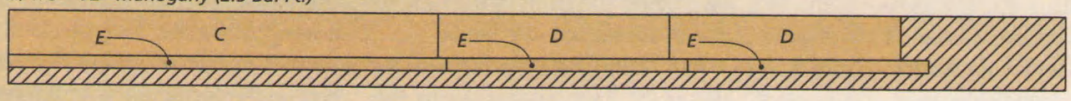
Materials, Supplies & Cutting Diagram

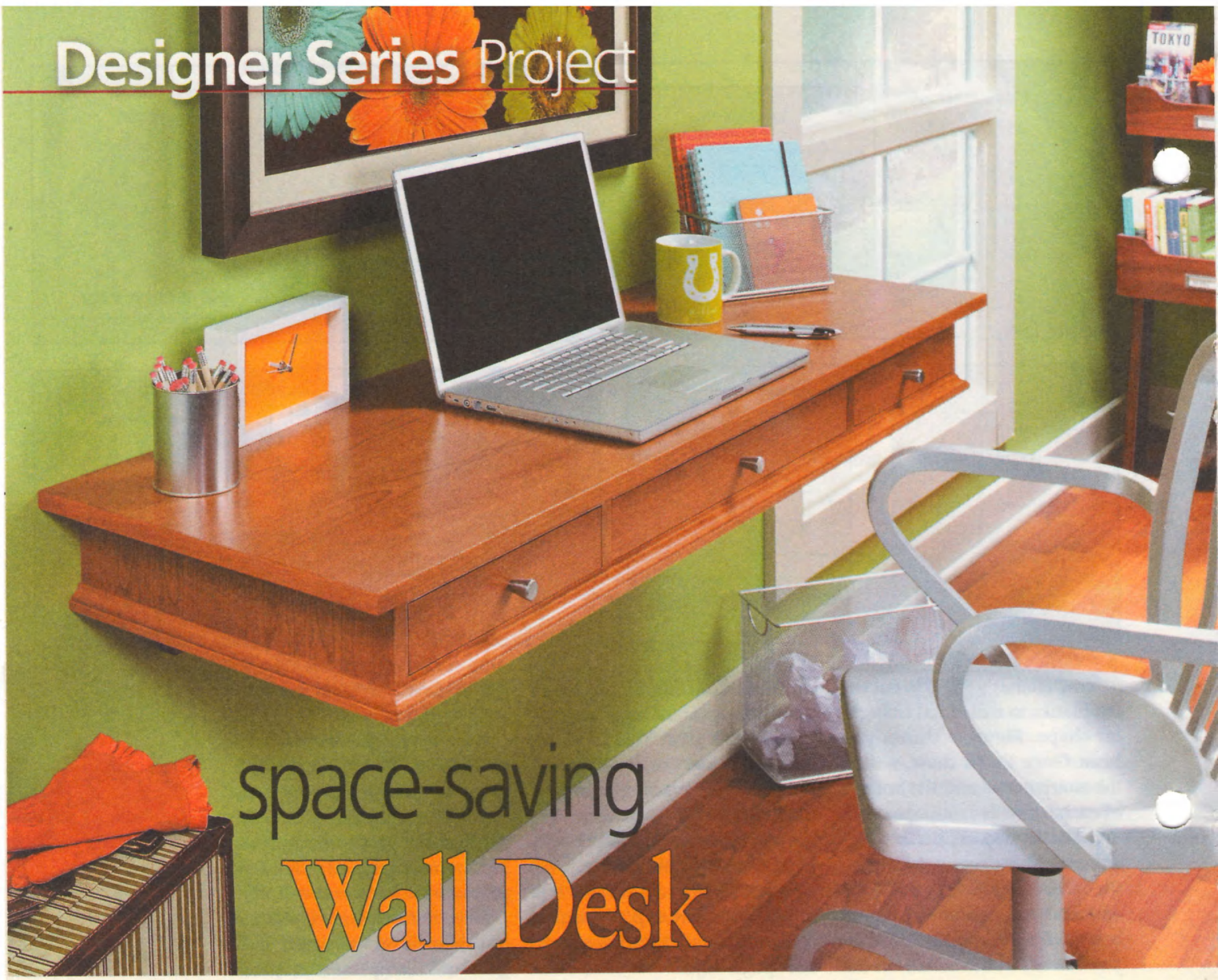
A	Front Leg (1)	1 1/2 x 1 1/2 - 26	D	Side Rails (2)	1/2 x 3 - 15 13/16
B	Back Legs (2)	1 1/2 x 1 1/2 - 26	E	Base Cap (3)	3/8 x 7/8 - cut to fit
C	Back Rail (1)	5/8 x 3 - 23			

1 1/2" x 4" - 60" Mahogany (2.5 Bd. Ft.)



3/4" x 5" - 72" Mahogany (2.5 Bd. Ft.)





space-saving Wall Desk

Whether it's a place for the kids to do their homework or just a handy spot for your laptop, this desk is the perfect solution.

When you think about desks, chances are you imagine a large, office-style design that dominates a room. But sometimes you just need a place to sit and jot down a few notes or sketch an idea for a new woodworking project.

For those moments, the wall desk shown above is perfect. Whether in the living room, a bedroom, or even in the kitchen, it doesn't take up a lot of space.

Although the desk seems to defy gravity, there's no magic involved. Actually, there's a very straightforward solution to mounting it to the wall.

BUILDING THE CASE

At the heart of the desk is a plywood case consisting of a top, bottom, two ends, and two dividers. A plywood back adds stability to the case. The top and bottom are rabbeted to form tongues that fit into dadoes in the ends. The dividers are housed in dadoes in the top and bottom. Three drawers slide on side-mounted drawer runners. Finally, you can add the edging on the front of the case to cover the plywood edges.

ENDS. The first step is to make the ends. As you can see in the main drawing and detail 'a' at right, they each have a pair of dadoes that house the tongues on the top and bottom panels. They're also rabbeted on the rear edge to hold the plywood back, as you can see in detail 'e.'

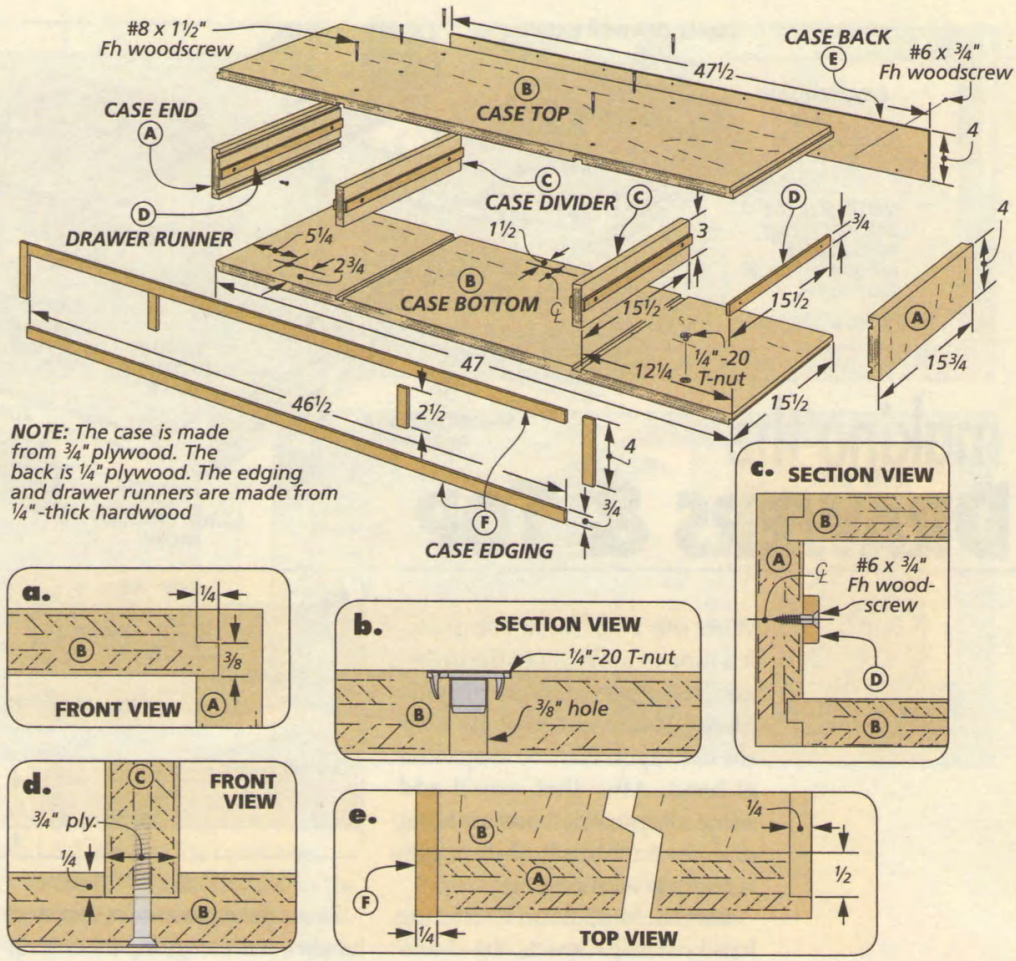
TOP & BOTTOM. Now you can cut the top and bottom panels to their final size. I used a dado blade installed in the table saw to cut the rabbets and dadoes on these panels. By adjusting the height of the blade, you can sneak up on a snug fit for the tongues in the dadoes in the ends. The How-To box on the facing page walks you through the process.

The last thing to do to the top and bottom is to drill a few holes. You'll need to start with the holes in both the top and bottom centered in the dadoes that hold the dividers. Then you can move on to drill and counterbore three holes for some T-nuts in the case bottom. These T-nuts accept a set of bolts to secure the brackets and a support block to the underside of the desk.

DIVIDERS. A pair of dividers defines the sizes of the three drawer compartments. All you need to do for the dividers is cut them to final size. Then you can turn your attention to the drawer runners. They need to be installed before you assemble the case since it would be difficult to reach inside and attach them after assembly.

The runners are just hardwood strips cut from ¼"-thick stock. All you need to do is drill countersunk screw holes to attach the runners. (On the opposite sides of the dividers, make sure to stagger the screw holes, so they don't contact each other.) It's a good idea to make an extra runner to use for sizing the grooves in the drawers later.

BACK. All that remains to complete the case is the back. I used ¼" plywood to overlap the ends and fit flush with the top and bottom. After predrilling the countersunk screw holes, you're ready to assemble the case.

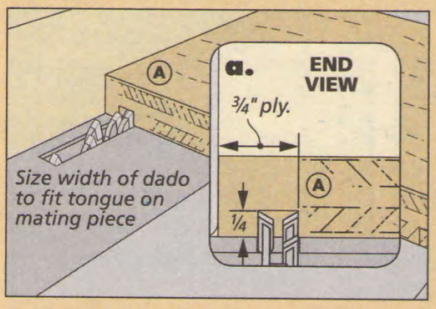


ASSEMBLY. Before gluing everything together, I took the time to dry-fit the assembly to ensure that everything fit well and the case was square. Then just add glue to the joints and clamp it up. Attach the back using screws.

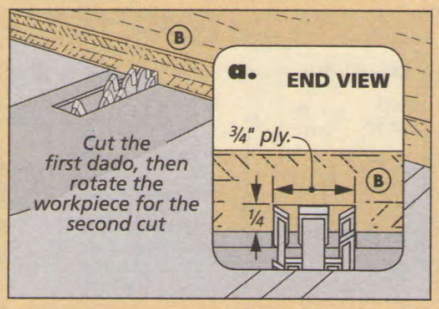
EDGING. To cover the exposed plywood, I made hardwood edging. Like I did for the drawer runners, I simply ripped strips from the edge of a ¾"-thick board. While you're at it, it's always a good idea to cut an extra piece or two in case you need a second chance when fitting the edging.

To install the edging, glue on the vertical end pieces first. Then cut the top and bottom strips to fit, and glue them in place. Finally, install the short edging pieces over the dividers.

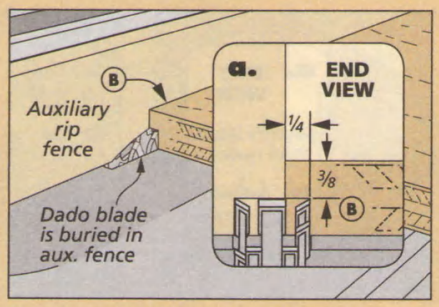
How-To: Strong & Sturdy Case Joinery



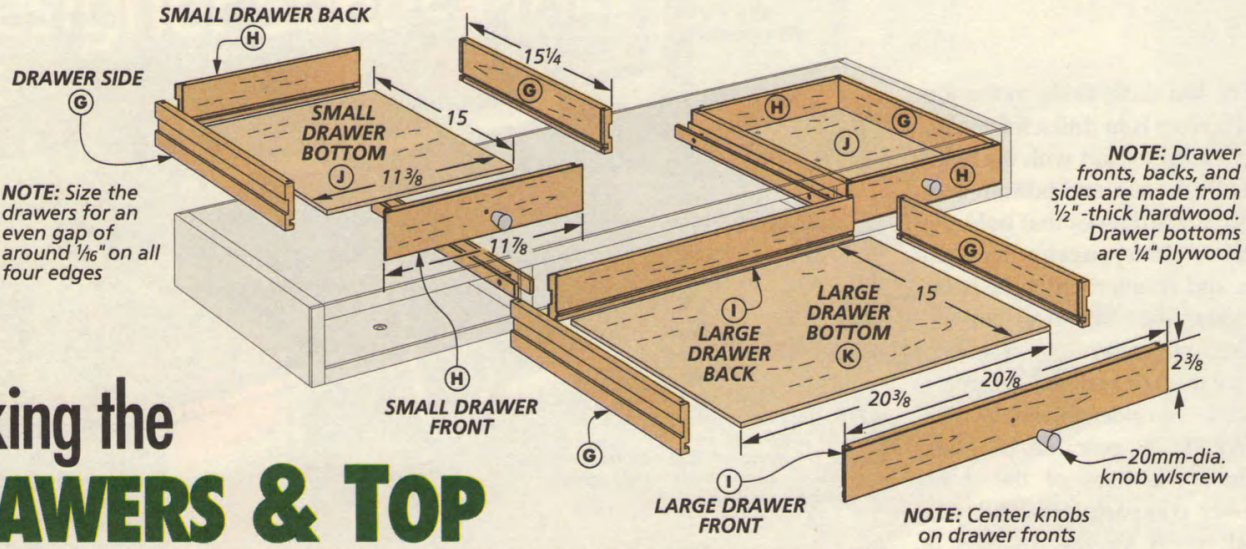
Dado the Ends. *Now cut a pair of dadoes in each of the end panels to accept the tongues in the top and bottom.*



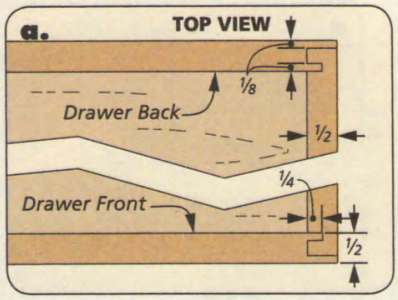
Dadoes. *Use the rip fence as a stop to position the cuts and install an auxiliary miter gauge fence to guide the workpiece.*

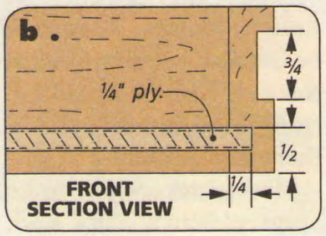


Rabbets. *With the dado blade buried in an auxiliary rip fence, cut rabbets on the top and bottom pieces.*



making the DRAWERS & TOP





With the basic case complete, it's time to move on to the drawers. The three drawers provide plenty of convenient storage for the items you want to keep close at hand. After that, you'll add some shop-made base molding and cove molding, then a plywood top with edging.

DRAWERS. In addition to offering handy storage space, the drawers have another purpose — they also make the project look more like a traditional desk.

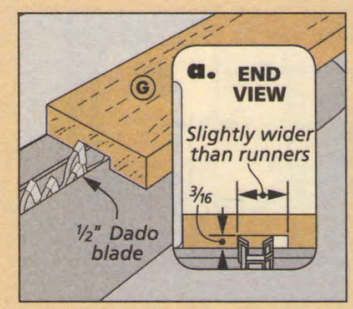
The drawers feature grooves in the sides that slide on the shop-made runners you installed in the case earlier. As you can see in detail 'a' above, I relied on locking rabbet joinery for the drawers. This joint gives them plenty of strength and can be made quickly and easily at the table saw.

Since the drawers are identical heights, you can group the cutting tasks to make construction more efficient. For instance, I ripped all the drawer parts to width first. Then just cut the sides all the same length. Finish up by cutting the fronts and backs to final length.

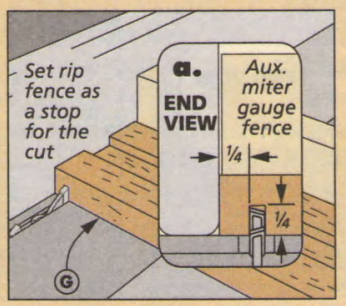
SIDES. After cutting the drawer pieces, you can use dado blade to cut the shallow grooves in the sides for the drawer runners. The key here is to find the "just right" fit — not too tight, but not too loose. It's a good idea to do a few test cuts to zero in on a perfect fit. I used a cut-and-flip method to guarantee the grooves were centered on the sides (left drawing below).

Now it's time to cut the locking rabbet joinery on the drawers. The box below shows you how. Finish up by cutting a groove on the inside of the drawer pieces to hold the bottoms. After cutting the plywood drawer bottoms to size, you can assemble

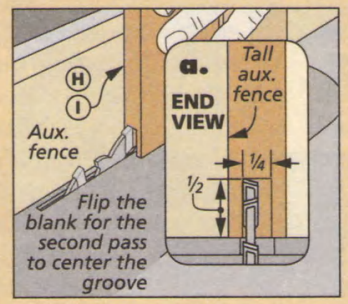
How-To: Cut Locking Rabbet Joinery



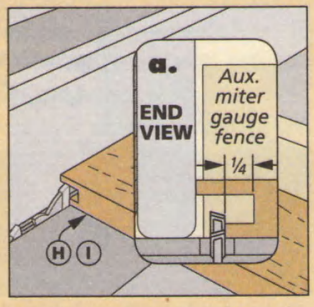
Centered Groove. *Make the first cut near the center, then flip the workpiece end for end.*



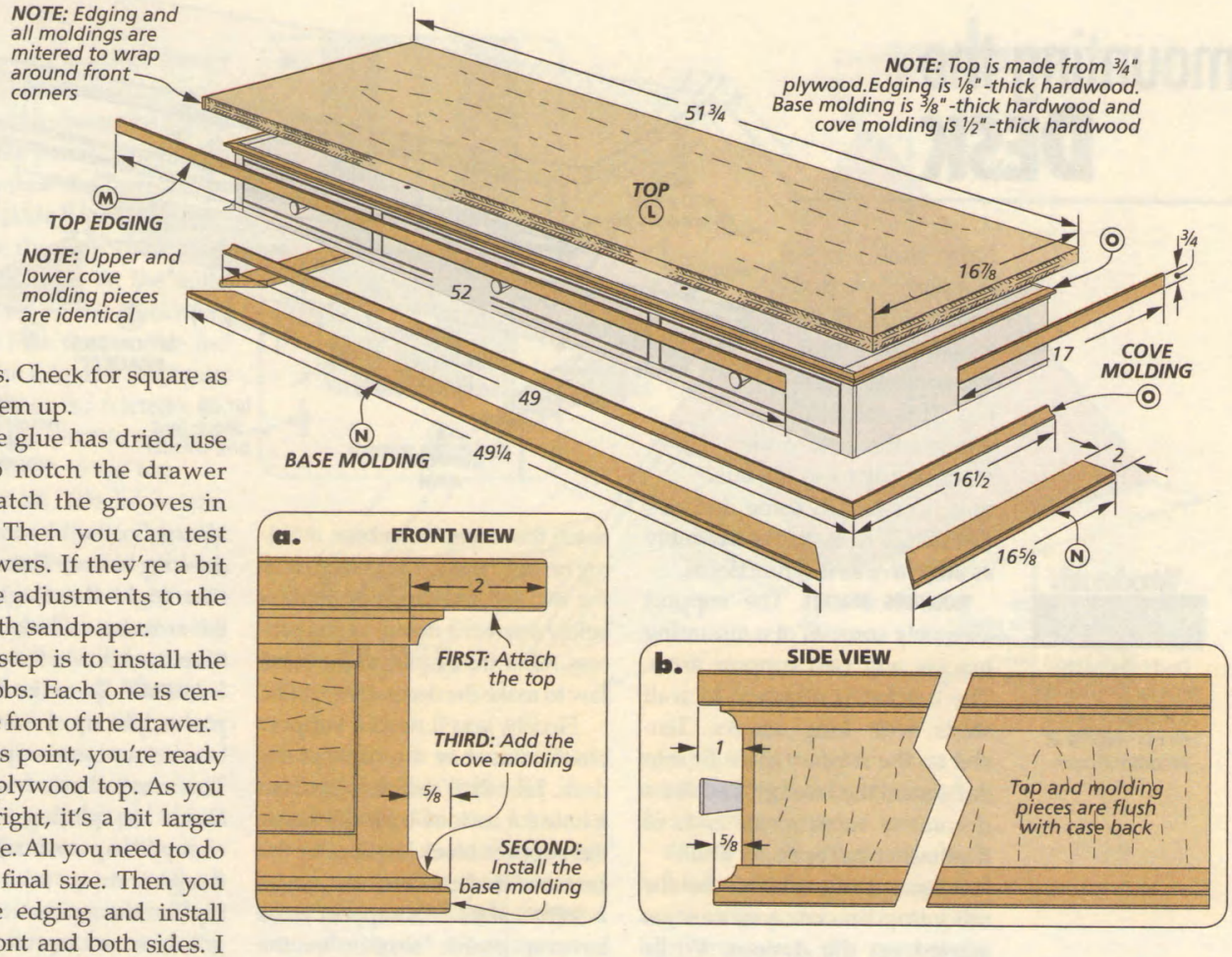
Kerf. *Use the miter gauge with an auxiliary fence to cut a kerf near the ends of the sides.*



Deep Groove. *With a tall fence installed to support the workpiece, cut a deep groove.*



Remove Tongue. *Trim the tongue on the inside face to fit the kerf in the drawer side.*



the drawers. Check for square as you glue them up.

When the glue has dried, use a chisel to notch the drawer back to match the grooves in the sides. Then you can test fit the drawers. If they're a bit tight, make adjustments to the grooves with sandpaper.

The last step is to install the drawer knobs. Each one is centered on the front of the drawer.

TOP. At this point, you're ready to add the plywood top. As you can see at right, it's a bit larger than the case. All you need to do is cut it to final size. Then you can cut the edging and install it on the front and both sides. I cut the edging from a long hardwood blank. You'll also note that I mitered the corners for a neat appearance. Once that's done, glue the top to the case.

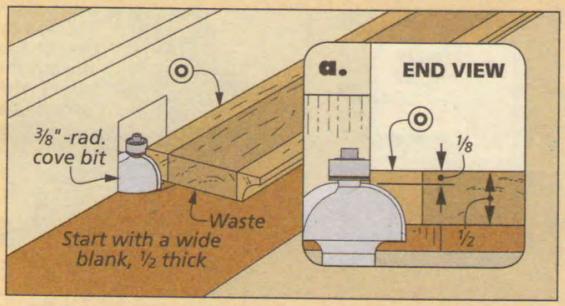
BASE MOLDING. A thin but wide base molding fits on the underside of the case. This flat molding helps balance the look of the desk after adding the top. It also provides a small ledge for the cove molding you'll add next.

To get started, plane some stock to ⅜". Then cut it to the proper width. Now all you need to do is miter the molding to fit. I attached it to the case with tape to prevent it from slipping while I glued and clamped it in place.

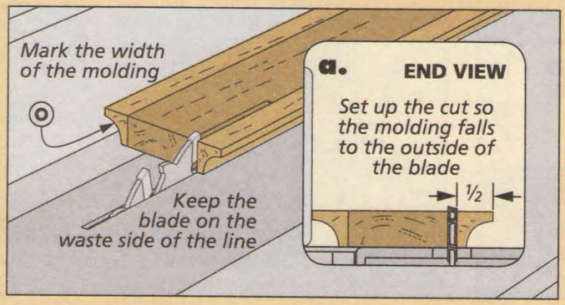
COVE MOLDING. For the transition from the case to the top and base molding, I installed some cove molding (detail 'a'). The nice thing about this type of molding profile is that you can make it in the shop.

The easy and safe way to make this molding is to start with a wide blank and rout the ⅜"-radius cove on both edges. Then rip the molding from the blank at the table saw. The box below shows the details of both operations. To install the molding, miter the pieces to length and attach them with glue.

Make the Cove Molding

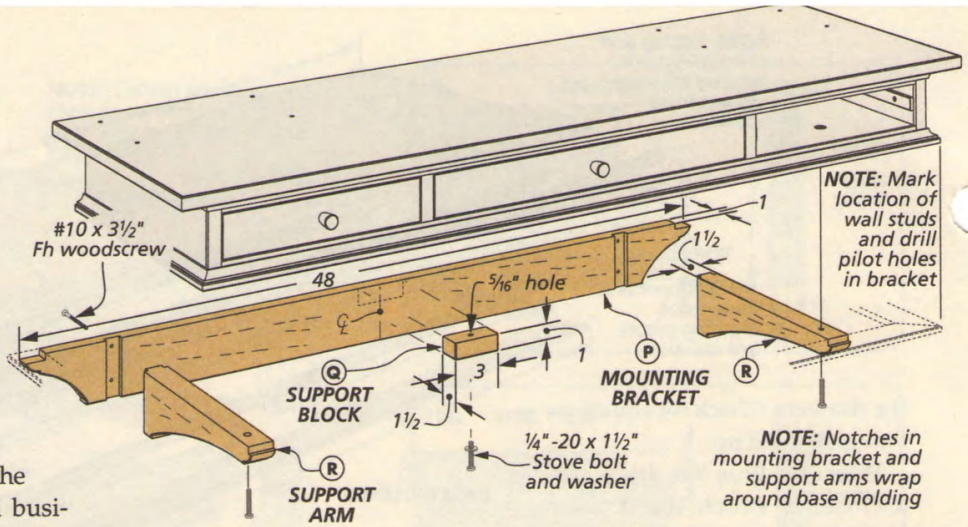


Rout Cove. *Start by cutting an extra-wide, hardwood blank. Then, set up the router table and rout the cove profile by making a series of shallow passes.*



Cut the Molding. *With the cove profile routed on both edges of the blank, move to the table saw and simply rip the molding strips free.*

mounting the DESK



Now that you've completed the desk and drawers, all that remains is to build the support assembly. This structure attaches the desk to the wall. But it's not all business. I've added some decorative details to make the assembly as attractive as it is functional.

MOUNTING BRACKET. The support assembly consists of a mounting bracket and two support arms. The bracket is attached to wall studs with long screws. Tenons on the support arms fit into dadoes on the bracket. I added a decorative curve to the ends of the bracket and arms, as well.

After cutting a blank for the mounting bracket, you can get started on the dadoes. While you're at it, you can also create the notch that accepts the base molding on both ends. The pattern and the two left drawings in the box below show the details of the process. After that, move to the band saw to make the decorative profile.

Finally, you'll need a support block to anchor the back of the desk. Just drill and counterbore a hole for a stove bolt, then glue the support block in place in the center of the bracket.

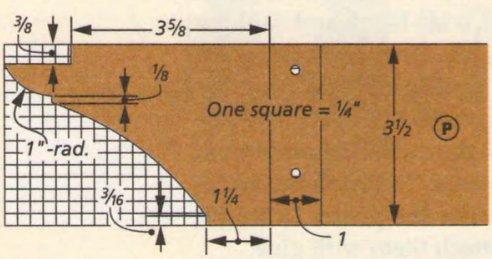
SUPPORT ARMS. The support arms have a profile similar to the bracket. You'll need to cut stub tenons on the blanks first (third drawing below). Then cut the profiles (right drawing). Complete the arms by drilling the holes for the stove bolts in the ends.

ASSEMBLY. To make sure all the pieces line up, I assembled the bracket and arms upside down. This way, all you need to worry about is getting the pieces clamped up and square. After the glue dries, take the assembly to the spot where you're going to mount it and mark the locations of the wall studs.

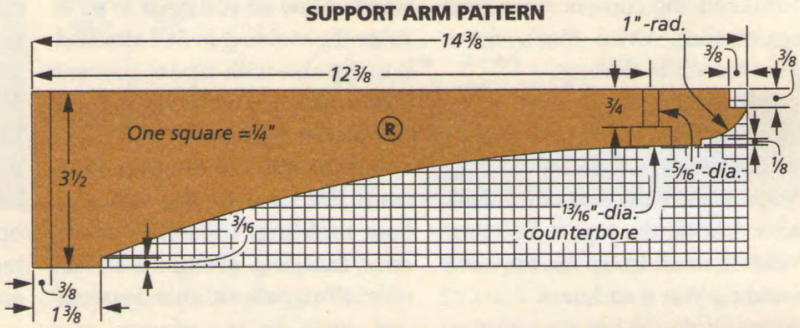
Woodsmith GO ONLINE EXTRAS

Find full-size patterns for the bracket and support arms on our website at Woodsmith.com.

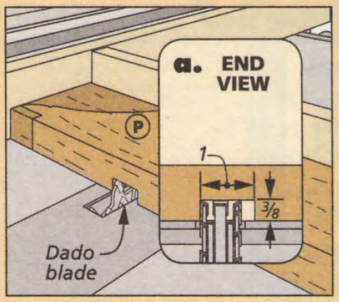
BRACKET END PATTERN



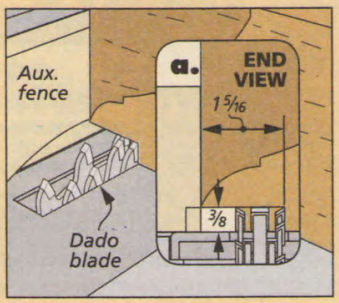
SUPPORT ARM PATTERN



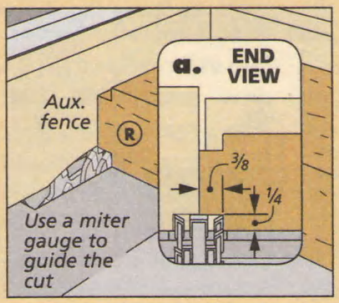
How-To: Shaping the Bracket Parts



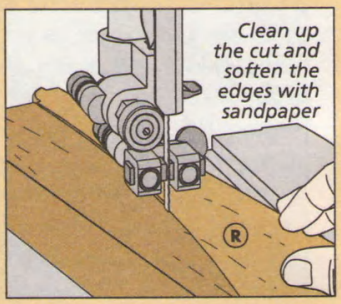
Dado. *The first step is to cut the two dadoes that will house the support arms.*



Notch. *Set the rip fence to act as a stop to when you cut the notches on each end.*



Tenon. *Bury part of the blade in an auxiliary rip fence to cut the tenons on the support arms.*



Band Saw. *Lay out the curve and keep the blade on the waste side of the line during the cut.*

You'll need to drill pilot holes in the bracket and in the wall studs to ensure a strong connection.

To attach the desk, set it in position with the base molding in the notches on the support arms and bracket. Make sure the fit is good at all points before you attach the desk using stove bolts.

DESKTOP CUBBIES

A pair of optional desktop cubbies allows you to keep things a little more organized by offering a fenced-off space. They're simple to make, but they echo the design of the support assembly and add a nice look to the finished piece.

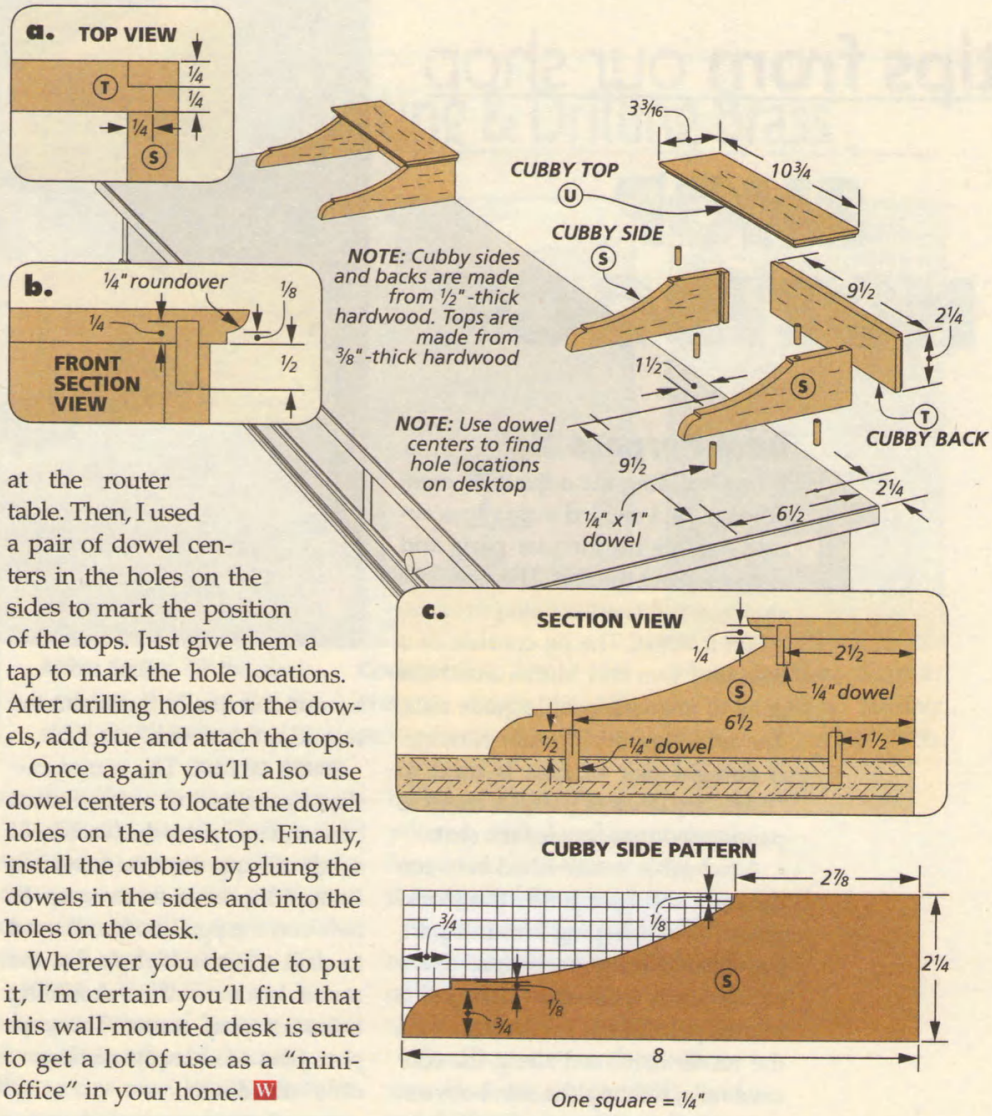
SIDES. I started by making the four sides and cutting a dado on the rear edge of each one to hold the backs (detail 'a'). Then you can drill the dowel holes as shown in detail 'c.' I turned to the band saw to cut the curves on the sides and then cleaned up the cuts with a little hand sanding.

BACKS. Now you can cut the backs to size and add the rabbets. I assembled the sides and backs using glue and clamps.

TOPS. I routed the profile along the front and sides of the tops at the router table. Then, I used a pair of dowel centers in the holes on the sides to mark the position of the tops. Just give them a tap to mark the hole locations. After drilling holes for the dowels, add glue and attach the tops.

Once again you'll also use dowel centers to locate the dowel holes on the desktop. Finally, install the cubbies by gluing the dowels in the sides and into the holes on the desk.

Wherever you decide to put it, I'm certain you'll find that this wall-mounted desk is sure to get a lot of use as a "mini-office" in your home. W

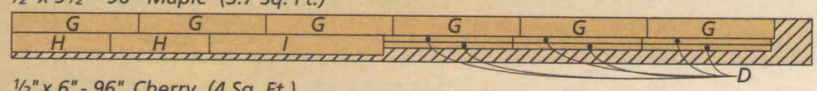


Materials, Supplies & Cutting Diagram

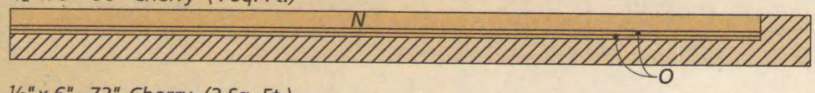
A	Case Ends (2)	3/4 ply. - 4 x 15 3/4
B	Case Top/Bottom (2)	3/4 ply. - 15 1/2 x 47
C	Case Dividers (2)	3/4 ply. - 3 x 15 1/2
D	Drawer Runners (6)	1/4 x 3/4 - 15 1/2
E	Case Back (1)	1/4 ply. - 4 x 47 1/2
F	Case Edging (1)	1/4 x 3/4 - 120 rgh.
G	Drawer Sides (6)	1/2 x 2 3/8 - 15 1/4
H	Sm. Dr. Fronts /Backs (4)	1/2 x 2 3/8 - 11 7/8
I	Lg. Dr. Front /Back(2)	1/2 x 2 3/8 - 20 7/8
J	Sm. Dr. Bottoms (2)	1/4 ply. - 11 3/8 x 15
K	Lg. Dr. Bottom (1)	1/4 ply. - 20 3/8 x 15
L	Top (1)	3/4 ply. - 16 7/8 x 51 3/4
M	Top Edging (1)	1/8 x 3/4 - 90 rgh.
N	Base Molding (1)	3/8 x 2 - 90 rgh.
O	Cove Molding (1)	1/2 x 1/2 - 175 rgh.
P	Mounting Bracket (1)	1 x 3 1/2 - 48
Q	Support Block (1)	1 x 1 1/2 - 3
R	Support Arms (2)	1 1/2 x 3 1/2 - 14 3/8
S	Cubby Sides (4)	1/2 x 2 1/4 - 8
T	Cubby Backs (2)	1/2 x 2 1/4 - 9 1/2
U	Cubby Tops (2)	3/8 x 3 3/16 - 10 3/4

- (12) #8 x 1 1/2" Fh Woodscrews
- (30) #6 x 3/4" Fh Woodscrews
- (4) #10 x 3 1/2" Fh Woodscrews
- (3) 1/4"-20 T-Nuts
- (3) 1/4"-20 x 1 1/2" Stove Bolts
- (3) 1/4" Flat Washers
- (3) 20mm Steel Knobs w/Screws

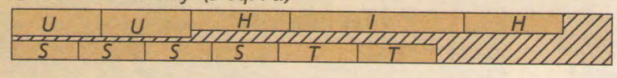
1/2" x 5 1/2" - 96" Maple (3.7 Sq. Ft.)



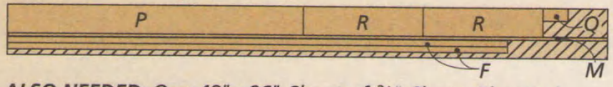
1/2" x 6" - 96" Cherry (4 Sq. Ft.)



1/2" x 6" - 72" Cherry (3 Sq. Ft.)



8/4" x 6" - 72" Cherry (6 Bd. Ft.)



***ALSO NEEDED:** One 48" x 96" Sheet of 3/4" Cherry Plywood, One 24" x 48" Sheet of 1/4" Birch Plywood*

SHOP NOTEBOOK

Dual-Purpose Jig

When building the adjustable stool on page 34, I needed a way to accurately shape the circular parts and also scoop out the seat. The router jig shown at right serves both purposes.

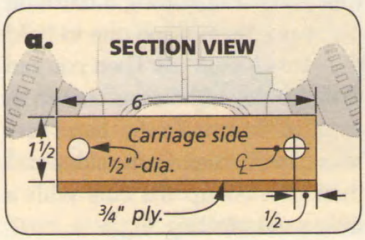
HOW IT WORKS. The jig consists of a base and two end blocks that hold pairs of interchangeable guide rails. The rails support a router carriage. A straight pair of rails is used to "turn" the circular parts. A concave pair is used to scoop out the seat.

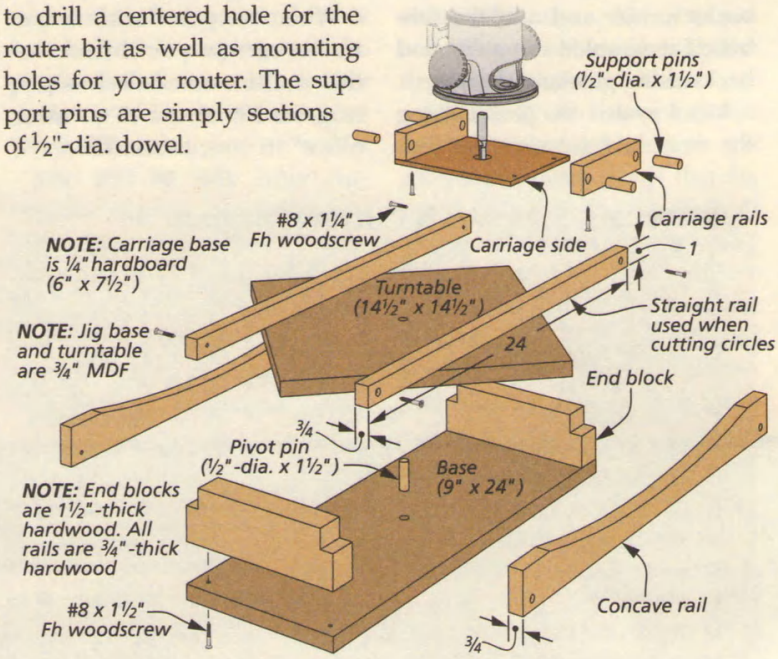
A turntable sandwiched between the rails and base holds the workpiece. When shaping a round part, the router carriage is clamped to the straight rails while the workpiece is rotated past the bit. To scoop the seat, the router is moved along the concave rails, rotating the seat between passes (photo above and detail 'b').

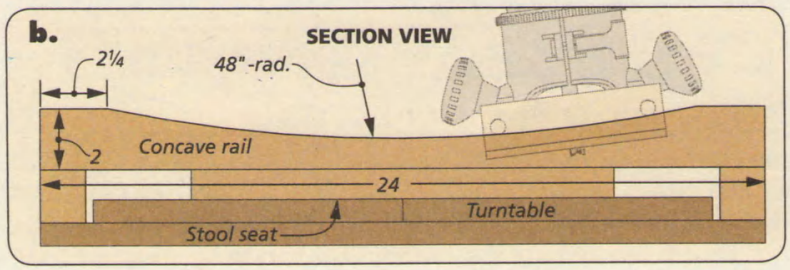
SIMPLE CONSTRUCTION. The base and turntable can be cut from ¾" MDF. Then before attaching the notched end blocks to the base, drill a centered hole for a ½"-dia. pivot pin and a matching hole in the turntable.

The straight guide rails are simply cut to size from ¾"-thick hardwood. The concave guide rails require more work. The curves needs to be accurate and consistent. So after cutting these rails to overall size, I laid out the 48" radius on one piece with a shop-made beam compass. I cut and smoothed this rail and then used it to lay out and finally flush trim the second rail to match.

ROUTER CARRIAGE. The router carriage consists of a hardboard base and two sides that each hold a pair of support pins (detail 'a'). I sized the base for a snug fit between the jig rails. You'll need to drill a centered hole for the router bit as well as mounting holes for your router. The support pins are simply sections of ½"-dia. dowel.







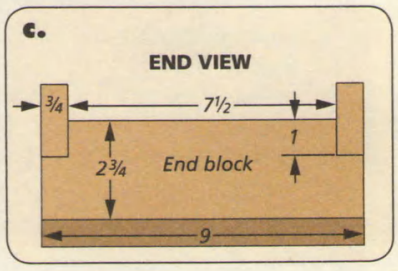


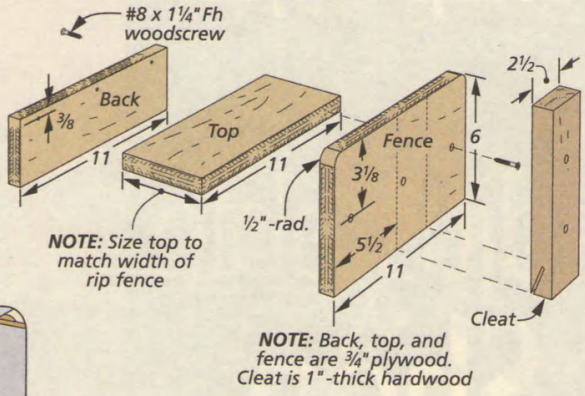
Table Saw Miter Jig

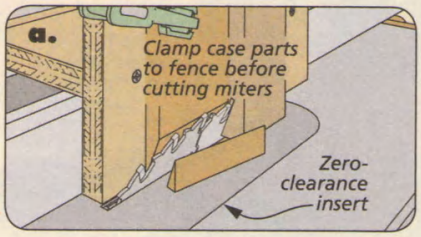
The flag case featured on page 18 presents a few interesting woodworking challenges. One of them is creating the 45° corners at the back of the case and lid.

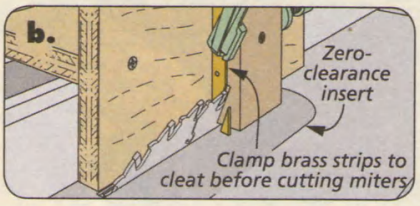
Making the corners requires cutting 22½° miters on mating boards. Since a table saw can't make this cut with the parts lying flat on the table, I came up with this jig to hold the pieces vertically.

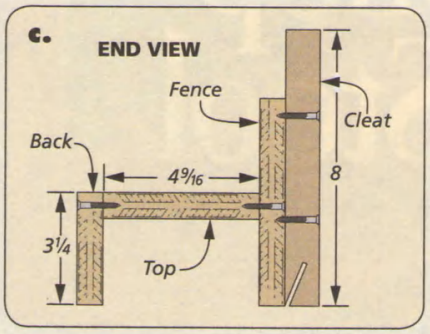
As you can see, the sled is simple to make. It's just a U-shaped assembly that's sized to straddle your table saw's rip fence. (You'll want a fit that slides smoothly here.) A cleat aligns the workpiece and backs up the cut.

To cut miters with the jig, you simply tilt the blade to the proper angle (67½° for 22½° miters), stand the workpiece on end and clamp it to the jig. Finally, adjust the rip fence before making the cut (detail 'a'). I also used the jig to miter the brass trim pieces for the flag case. For these cuts, you just clamp the brass strips to the cleat as shown in detail 'b.'









Slot-Cutting Sled for Mitered Splines

After assembling the case and lid of the flag case (page 18), I cut slots in the mitered corners and then added hardwood splines. This helps strengthen the joints, and it also adds a nice decorative touch.

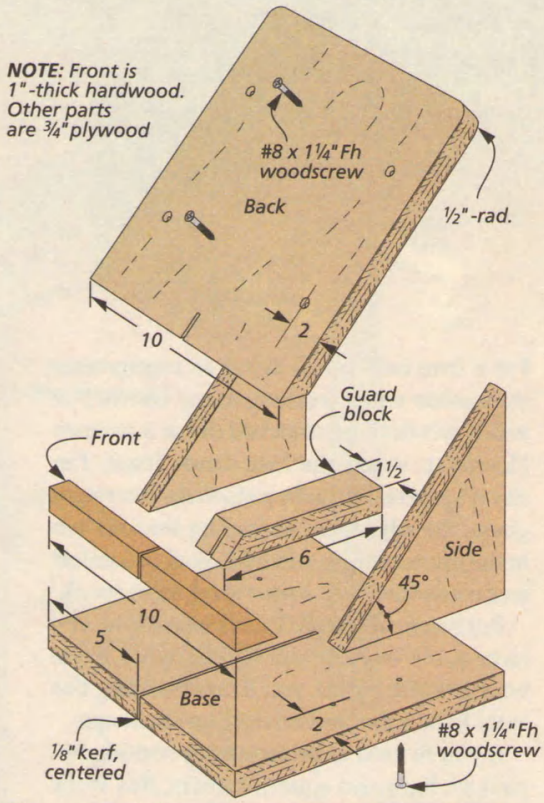
Cutting the slots requires a sled that carries the assemblies through the table saw blade at the proper angle. The sled shown at right fills the bill.

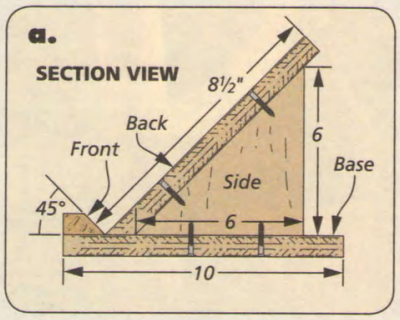
The sled consists of a base that rides against the rip fence, a back that supports the case, and a front that positions the case at the right angle. A pair of sides position and support the back. And a guard block protects your hands from the blade.

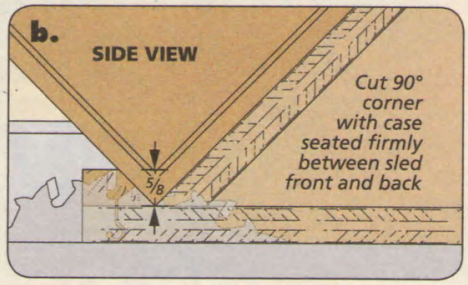
After cutting the parts to size and screwing them together, you can use the rip fence to center the jig on the blade. Now cut a kerf in the jig as shown in the illustration at right. Then you can use that kerf to align the marks for each slot before cutting them.

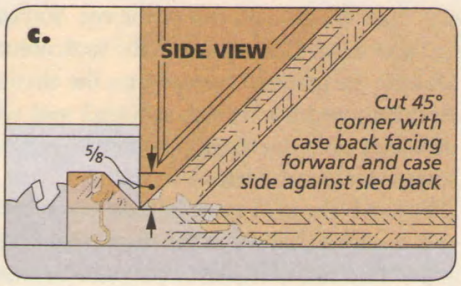
The triangular-shaped flag case has a 90° corner and two 45° corners, so you'll use this jig in a couple of ways to cut slots on the case. First, align the 90° corner in the joint between the sled front and back before cutting those slots (detail 'b').

Then, to cut consistent slots in the 45° corners, have one of the case sides clamped against the back of the sled. The case back should always be facing forward for these cuts (detail 'c'). W



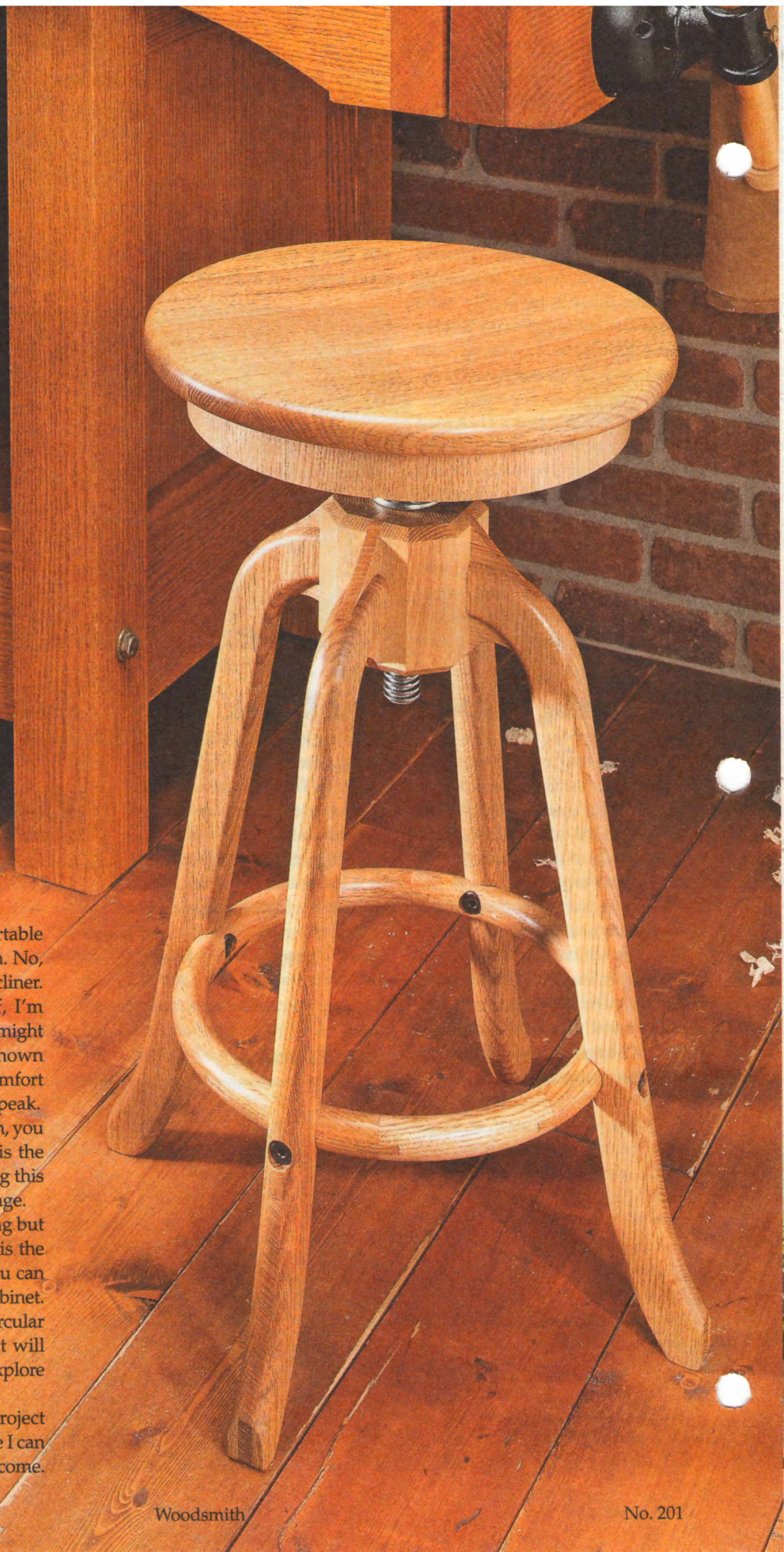






adjustable Shop Stool

This attractive and sturdy swiveling stool will be the perfect complement to your workbench.



I'm a firm believer in being as comfortable as possible when working at my bench. No, you won't find me stretched out in a recliner. However, when the task lends itself, I'm always perched on a shop stool. As you might guess, the adjustable, swiveling stool shown in the photo at right takes this goal of comfort and convenience to a new level, so to speak.

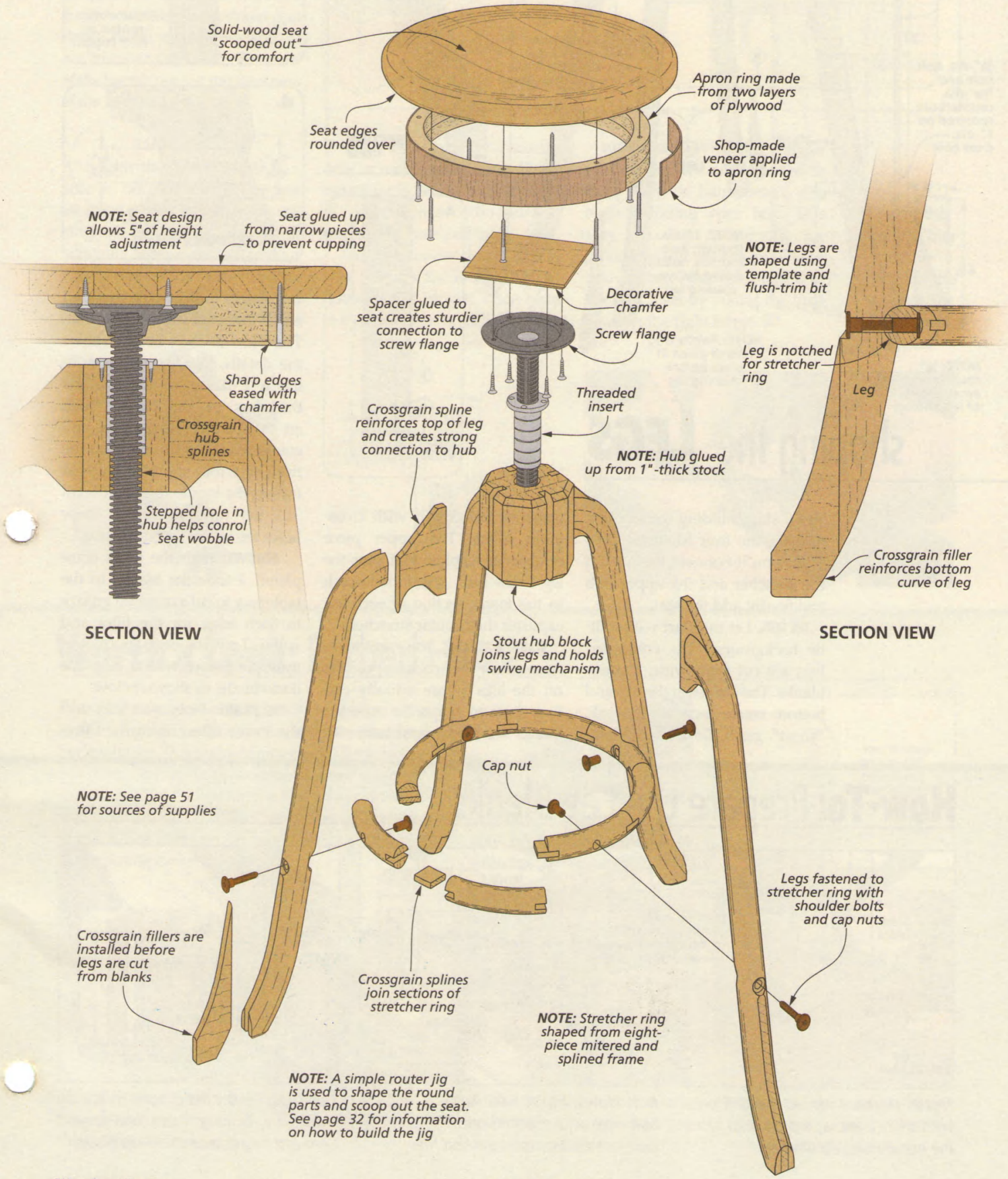
But before you settle in and take a spin, you have some work to do. Maybe work is the wrong word. I think you'll find building this stool to be a fun and interesting challenge.

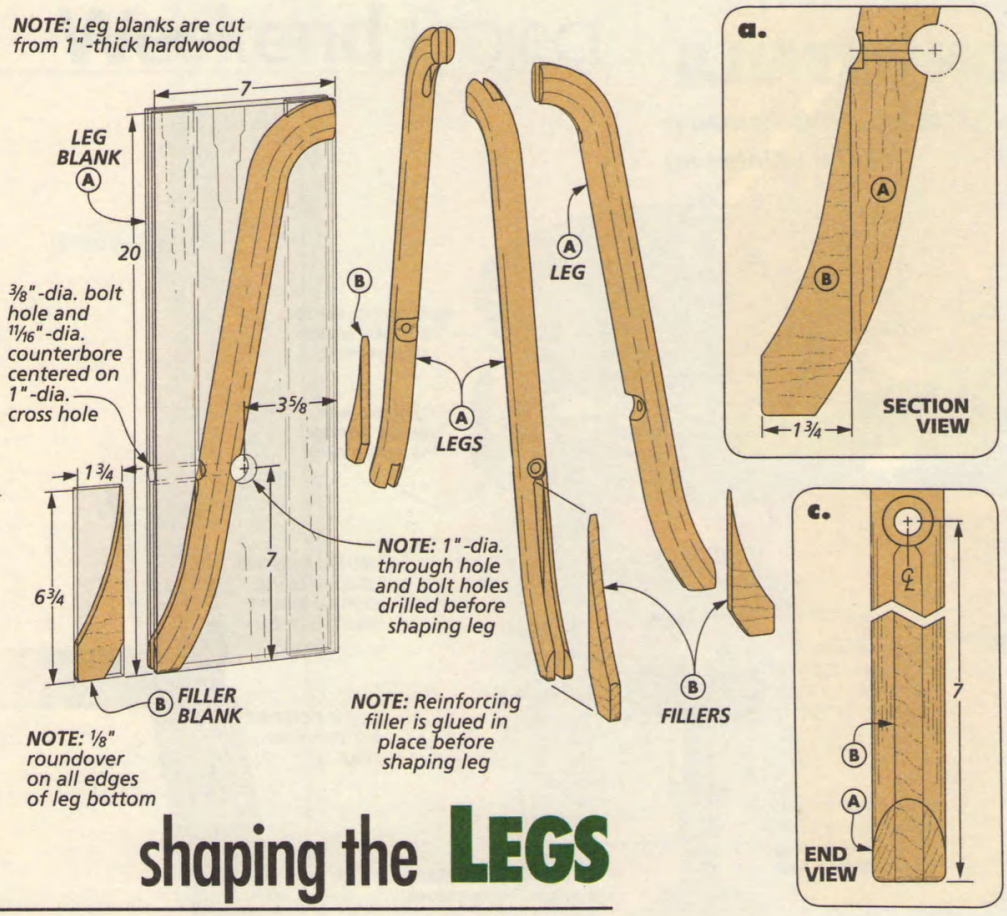
If you're tired of projects with nothing but straight lines and square corners, this is the one that will get you out of the rut. You can just about leave the square in the tool cabinet. Making the graceful curved legs, the circular stretcher, and the round, scooped seat will definitely give you the opportunity to explore some new woodworking territory.

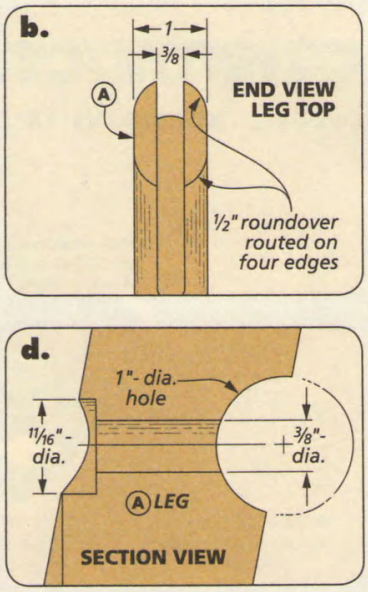
For me, the real treat is that this project gets to stay right here in the shop where I can enjoy the fruits of my labor for years to come.

CONSTRUCTION DETAILS

OVERALL DIMENSIONS: 18"D x 18"W x 29"H (Maximum)
24"H (Minimum)







shaping the LEGS

You'll start building the stool by making the four identical legs. Then you'll connect them with the stretcher and the upper hub and finally, add the seat.

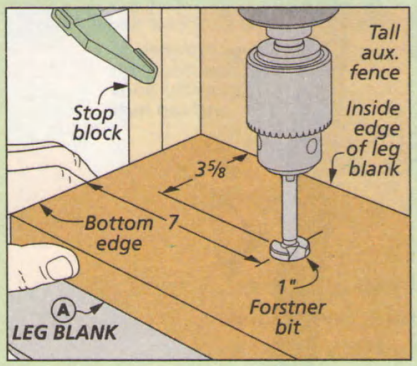
THE LEGS. Let me start with a little background. The contoured legs are cut from wide, 1"-thick blanks. The curves at the top and bottom create sections of weak, "short" grain. So both of these areas are reinforced with cross-grain fillers. The upper piece doubles as a spline that joins the leg to the hub. A rounded notch in the lower section of each leg captures the circular stretcher.

BLANKS & NOTCHES. You want to do as much of the work as possible on the legs before actually cutting them to shape. So once the blanks are ready, your next step is to begin forming the rounded notch that captures the stretcher. The How-To box below shows the details. You'll start by drilling a 1"-dia. hole through the thickness of the blank. Then an intersecting shank hole and counterbore are drilled from the front edge for a shoulder bolt that fastens the legs to the ring (detail 'd'). Set up carefully so these holes are located accurately.

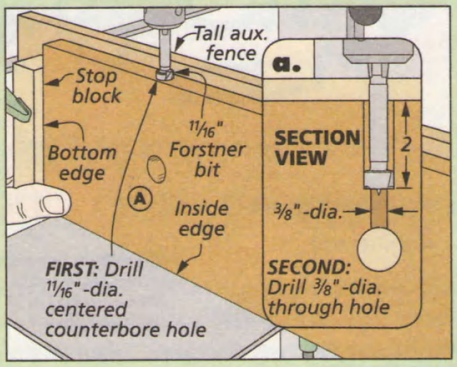
GROOVES. With the holes completed, I took the blanks to the table saw to cut a centered groove in each edge for the filler and spline. I cut the deep grooves in multiple passes with a 1/4"-wide dado blade, as shown below.

THE FILLERS. Now you can add the lower fillers. Both the fillers

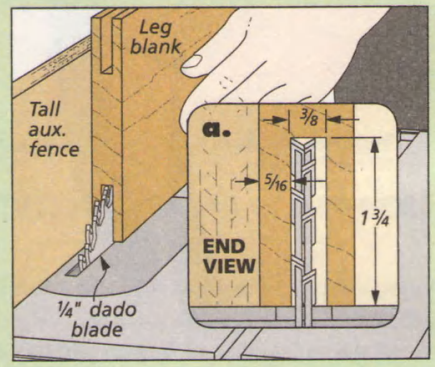
How-To: Prepare the Leg Blanks



Notch Holes. *I set up the drill press with a fence and a stop block to locate the notch holes accurately.*



Bolt Holes. *Install a tall fence to drill the bolt hole and counterbore. The counterbore comes first, then the bolt hole.*



Grooves. *Center the grooves in the leg blanks by flipping them end-for-end between passes over the dado blade.*

and splines are installed with the grain running perpendicular to that of the leg blanks. So I planed enough stock to thickness for both parts. You want a snug fit to the grooves. I fit the fillers slightly proud, glued them in, and trimmed them flush.

TEMPORARY FILLERS. Although you won't add the splines at this point, you do need to fit some temporary fillers to make it easier to shape the legs (Figure 1). I simply cut one long, T-shaped strip at the table saw, and then cut sections from it. To do the job, the fillers need to be a good fit all around. They can be spot glued into the bottom of the grooves.

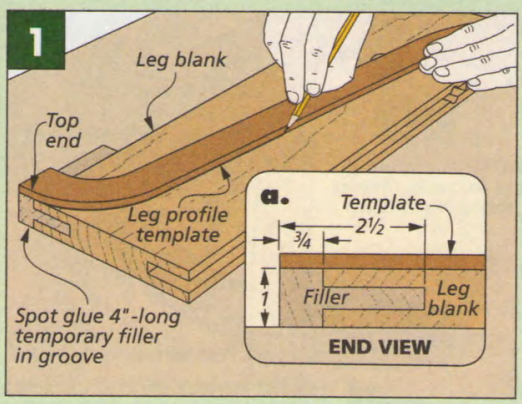
TEMPLATE. Now the blanks are ready to be shaped into graceful legs. To get this job done quickly and consistently, I made a hardboard template and then used it to flush trim the legs to shape. A ¼-scale pattern for the template is shown in the right margin. This will be your guide, so take the time to get the lines right.

SHAPED. The remaining steps are shown in the drawings at right. First, I used the template to lay out the profile on each blank. This was followed by a trip to the band saw to cut the legs to rough shape. If you stick close to the layout lines, you'll have less waste to trim away.

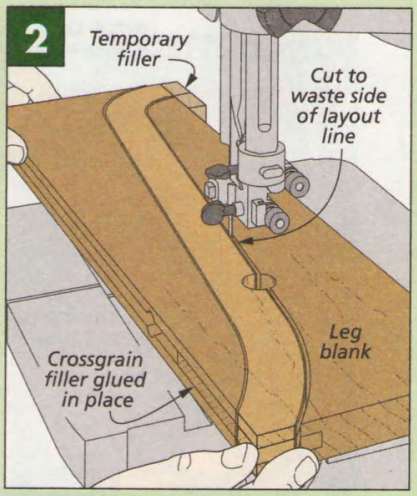
The template can now be attached to the blank with double-sided tape. When trimming the legs, my main concern was tearout — especially when routing uphill against the grain. Avoid this by taking light cuts and be sure to maintain a firm grip.

ROUNDOVER. The legs are completed by routing a ½" roundover on all four edges. Tearout is again an issue, so this is best done in multiple passes, raising the bit slightly after each series. One catch is that you'll have to avoid the notch on the back of the leg and the counterbore on the front. It's not difficult to complete the roundover across these sections with a file and sandpaper.

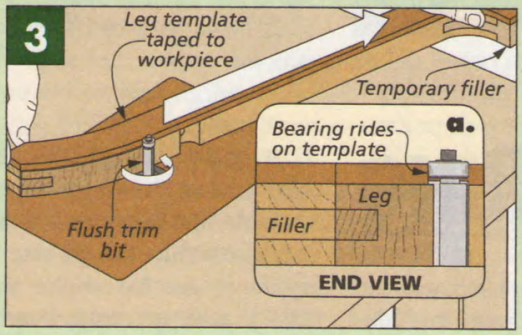
How-To: Final Shape



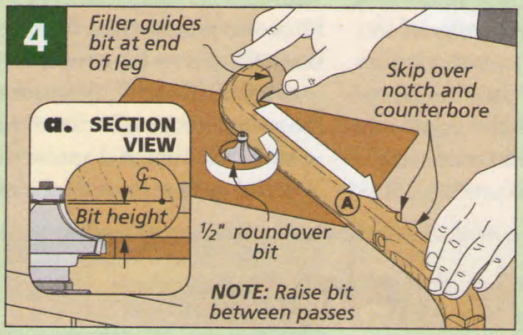
First, the Layout. *With the temporary fillers in place, use the template to lay out the contoured shape of the leg on each blank.*



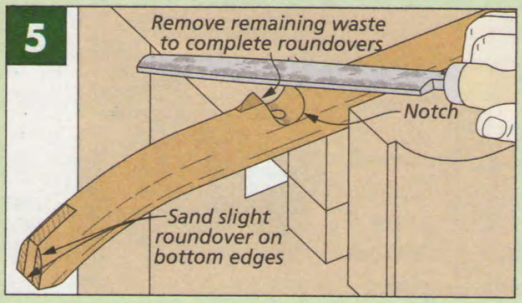
Rough Shape. *A ¼"-wide band saw blade allowed me to follow the curves of the leg closely.*



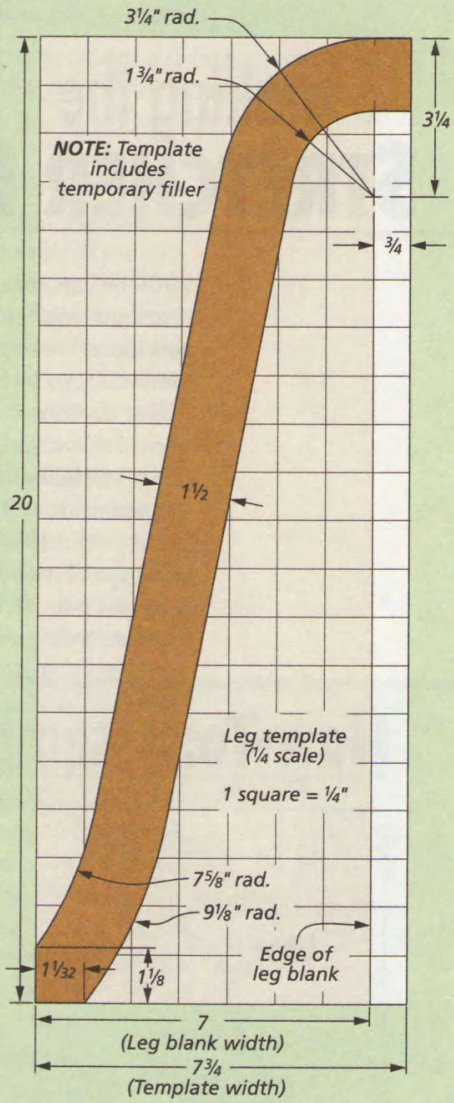
Flush Trim. *Make certain the template is firmly attached to the leg before routing it to final shape. Light skim cuts will work best.*



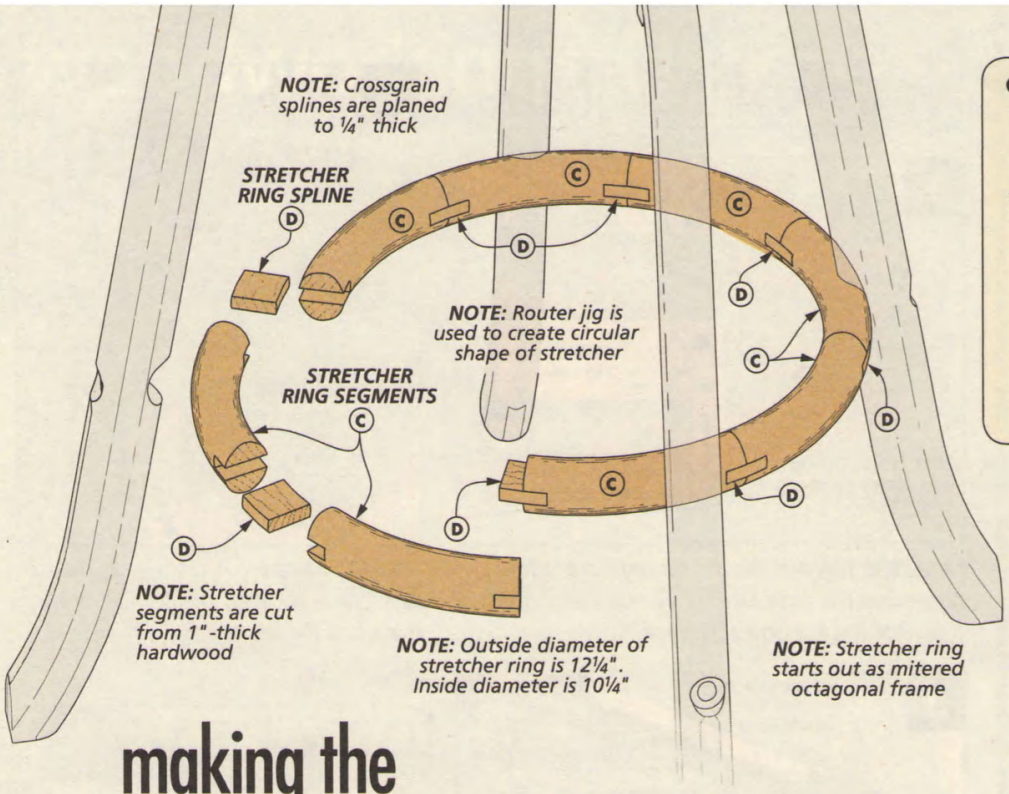
Four Roundovers. *The final pass is made with the bit a hair below center. You can round over the remaining flat spot with sandpaper.*

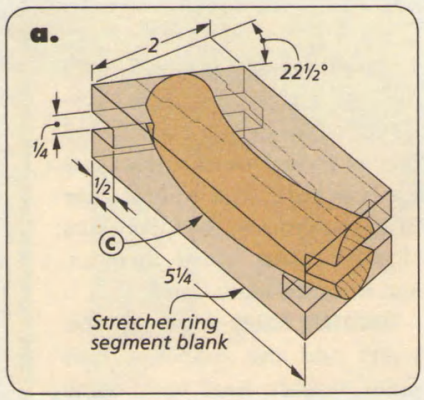


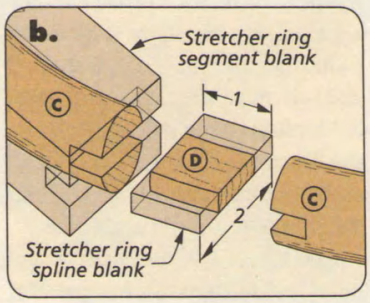
Final Shaping. *Use a file and sandpaper to complete the roundovers. Carefully blend the unshaped sections into the routed portion.*



Leg Profile Pattern. *You can enlarge the ¼-scale pattern above or use the dimensions given to make a leg template. Note: The template includes the temporary filler.*







making the STRETCHER RING

With the legs completed, you can begin making the parts that connect them. First up is the uniquely made circular stretcher.

The stretcher is round in both overall shape and profile. It starts out as an eight-sided mitered and splined frame. Then the frame is cut and routed into its circular shape. Finally, the edges are rounded over at the router table to create the round profile.

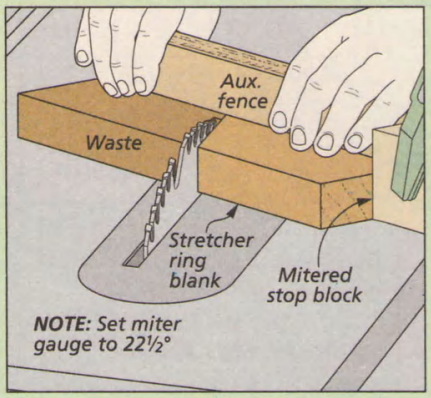
THE FRAME. The How-To box below shows the steps taken to assemble the octagonal frame. When mitering the pieces, the key is to get the angles right (22½°), and to make sure all the pieces are exactly the same length. Once the eight pieces were cut, I clamped them up with a band clamp to check the fit of the joints. Then be sure to mark the pieces for reassembly.

SPLINE SLOTS. A ¼" slot-cutter in the router table will make quick work of the centered spline slots. You can guarantee that the slots will align by placing the same face (top or bottom) of every piece against the table.

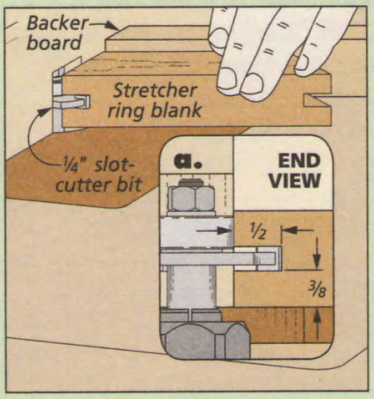
After cutting crossgrain splines to fit the slots, the frame can be glued up. You'll find this is easier to do in sections. A band clamp will pull the joints tight.

A JIG. Now you need to shape the frame into a 1"-wide ring with a diameter of 12¼". To simplify this and guarantee a precise result, I put together a router jig. The jig will see more action later when you use it to shape both the seat and the seat apron.

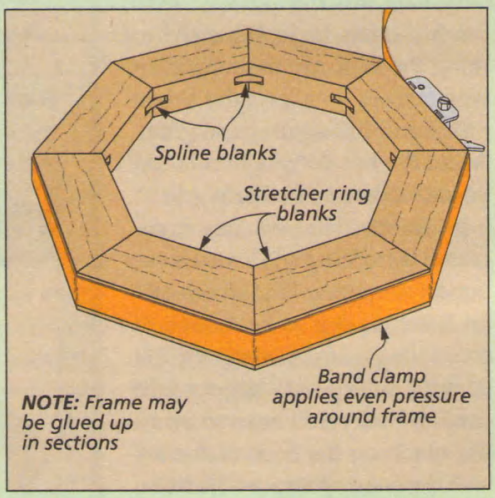
How-To: Assemble the Frame



Miters. *After mitering one end of each piece, position a stop block to ensure all the pieces end up the same length.*



Spline Slots. *I registered the same face against the table to ensure the slots in the pieces aligned.*



In Sections. *Make it easy on yourself by gluing up the frame in several stages. A band clamp will provide plenty of pressure.*

In brief, the jig consists of a platform that holds a pair of raised guide rails. The guide rails support a movable router carriage. A pivoting turntable sandwiched between the rails and platform holds the workpiece and allows you to create its round shape with a straight router bit. All the information needed to build the jig can be found on page 32.

Once the jig is assembled, you can put it to work. You'll need to shape both the inside and the outside of the frame to create the ring. The box at right leads you through the process.

LAYOUT. The first thing I did was mark a set of guidelines on the turntable. Then I used these lines to center the frame and lay out the inner and outer diameter of the ring, as in Figure 1.

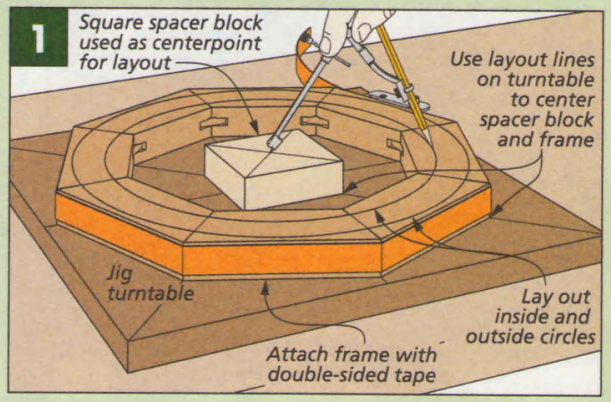
ROUGH CUT. Before routing the frame, it should be cut to rough shape. But first, I drilled a good-size starter hole for the router bit at the edge of each circle.

TAPE & TURN. I used double-sided tape to attach the rough-cut stretcher to the turntable. Center it by carefully aligning the frame joints with the guidelines.

You'll have to remove and then reinstall the rails to fit the turntable over the pivot pin. Then position the router carriage on the rails with the bit in the starter hole, and clamp it down. Depending on the amount of waste you have left, multiple passes may be best, adjusting the position of the router carriage in between.

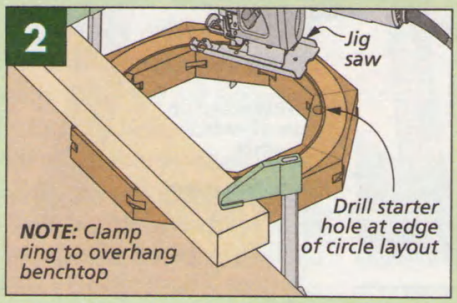
ROUNDOVERS. I created the round profile with a ½" roundover bit in the router table. The top and bottom edges on both the inside and outside of the ring need to be routed — four cuts. I found that an easy way to rout the ring was to make a pair of curved fences that match the inside and outside diameters of the ring. With the fence guiding the cuts, you don't have to rely on the bit's bearing. This allows you to make multiple passes as well as avoid "overcutting" the roundovers.

How-To: Stretcher Ring

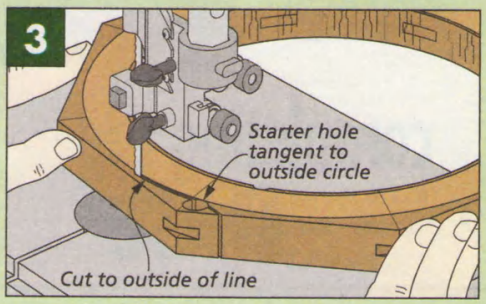


Initial Layout. *A series of lines drawn on the turntable help you center the frame. I used a pivot block and compass to lay out the shape of the stretcher.*

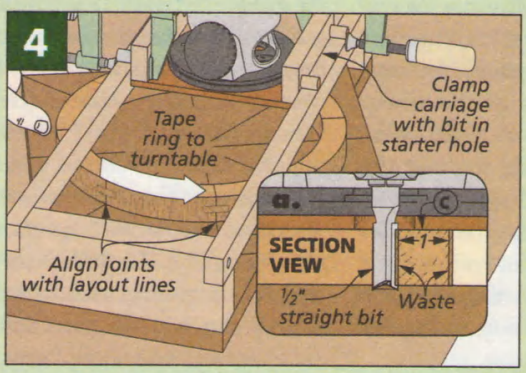
▲ The jig detailed on page 32 allows you to shape the stretcher ring easily.



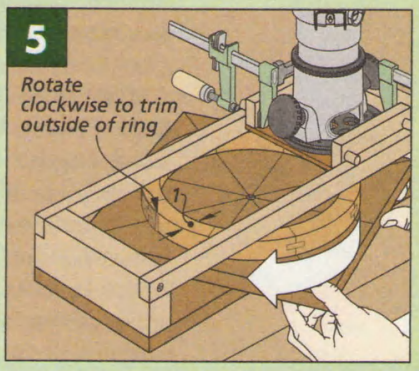
Jig Saw. *I removed the waste on the inside of the stretcher with a jig saw. Clamp the ring to the edge of your bench.*



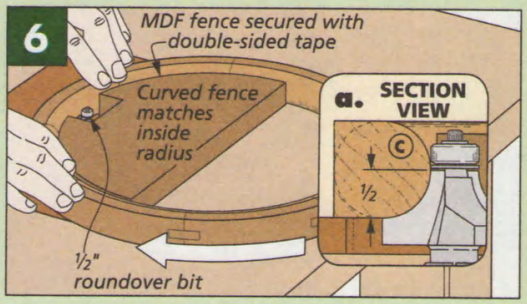
Then Band Saw. *I rough cut the outside of the ring to shape at the band saw. Leave about ⅛" of waste on each edge.*



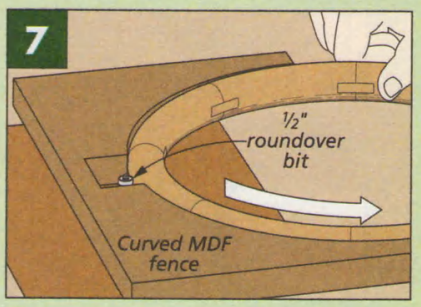
Inner Circle. *Be sure the bit has clearance and hold the turntable firmly while you turn on the router. Then slowly rotate it counterclockwise.*



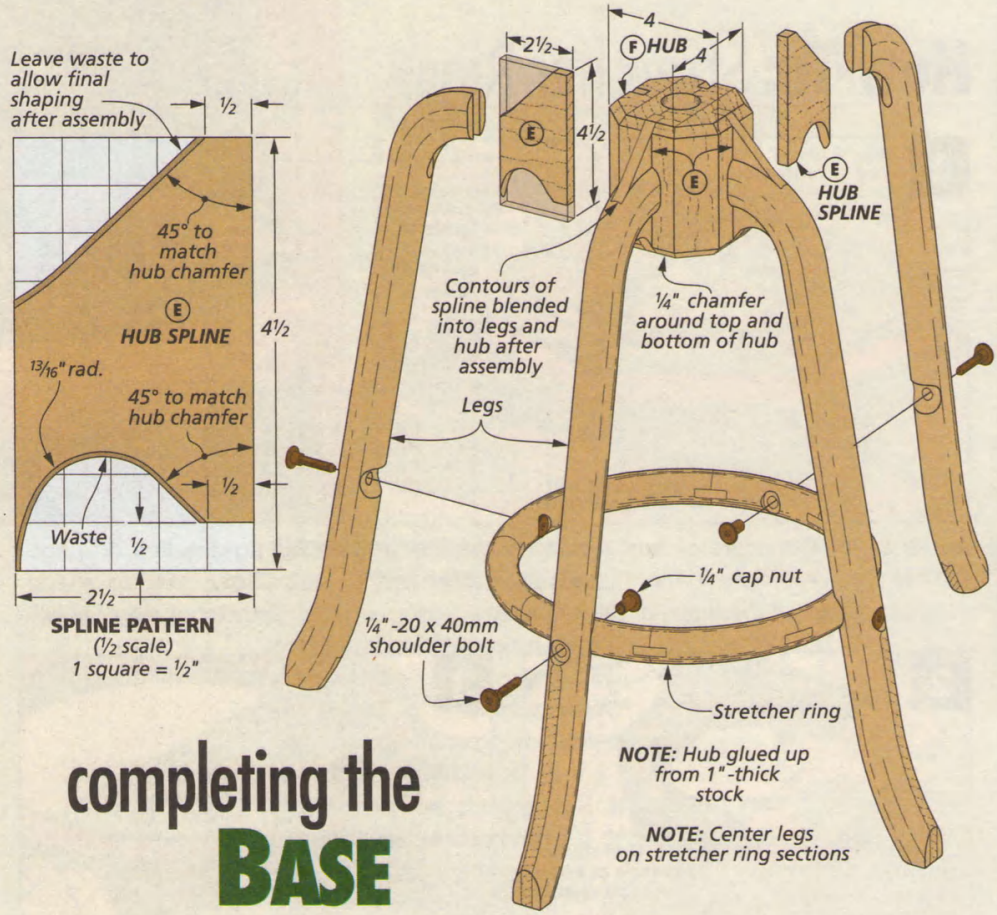
Outer Circle. *Reposition the carriage to rout the outer circle. The width of the ring should be exactly 1".*

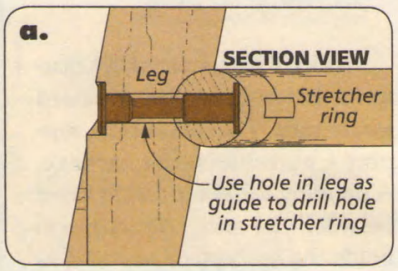


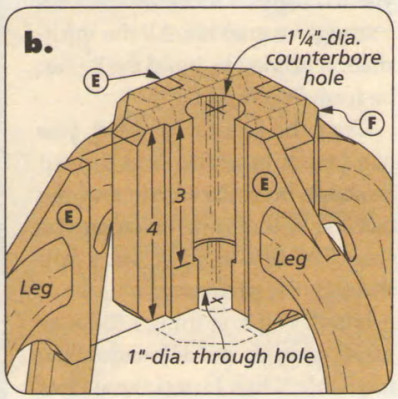
Convex Fence. *I installed a fence that matched the inside curve of the ring to rout the two inner roundovers. Make multiple light passes.*

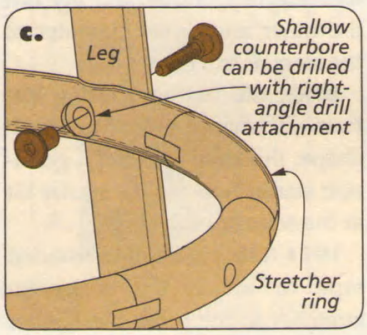


Outer Edges. *You can rout the outer roundovers with the same procedure, only this time with a concave fence.*









completing the BASE

The next task is not quite as challenging. You'll make the hub and spline assembly that connects the four legs and holds the swivel mechanism. And with this completed, you can assemble the base.

SPLINES FIRST. The hub is essentially a square block with a centered through hole to hold the swivel mechanism and a groove along each face to hold the splines (detail 'b'). But before making the hub, I worked on the four hub splines. You already have the material you thicknessed when making the leg fillers. And you'll need the splines in hand to size the grooves in the hub accurately.

Remember that the grain direction of the splines runs perpendicular to that of the hub and legs. When I shaped them, I left extra material at the transitions into the leg and hub. This allowed me to fine-tune the fit at these points after assembly. The pattern above and the drawings below show what you need to do.

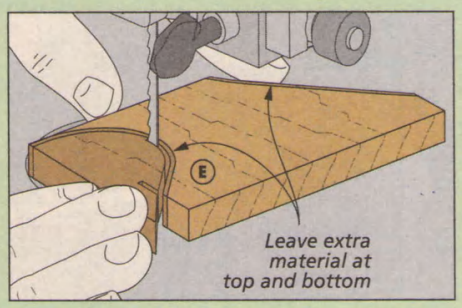
THE HUB. The hub begins as a 4"-square by 4"-long block glued up from 1"-thick stock. After gluing up the block and trimming it to size, the next task is to drill a stepped hole through the hub to accommodate the threaded insert that accepts the screw.

You'll start with a 1¼"-dia. by 3"-deep hole centered on the top of the hub for the insert. Then a 1"-dia. through hole is drilled from the bottom. This smaller hole hugs the screw to minimize wobble in the assembly.

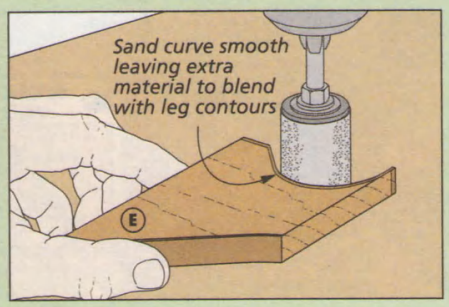
The goal is to drill the two holes perpendicular to the ends of the hub and centered on one another. The first two drawings in the How-To box on the opposite page show the drill press setup I used.

CUT THE CORNERS. After completing the holes, I took the block to the table saw to give it its octagonal shape (Figure 3). A little sanding will clean up the bevel cuts.

How-To: Shape The Splines



Lay Out & Cut. *The crossgrain splines can be laid out following the pattern above, then cut to rough size at the band saw.*



Sand Contours. *Use a sanding drum to smooth the center section of the contours, leaving the edges for final fitting.*

CHAMFERED. The next step is to soften the top and bottom edges of the hub with a ¼" chamfer. A chamfer bit in the router table will do the job. The hub can be held on end as each facet is passed across the bit (Figure 4).

THE GROOVES. Now comes the centered groove in each wide face that holds the spline. As you know, the width of the grooves needs to match the thickness of the splines you shaped earlier.

I cut the grooves in the hub with the same technique used for the grooves in the leg blanks (Figure 5). When they're completed, the splines should bottom out in both the leg and hub grooves and the end of the leg should butt tightly against the hub.

THE ASSEMBLY. With the hub and splines ready to go, you can start assembling all the pieces. The obvious question here is how and where to begin.

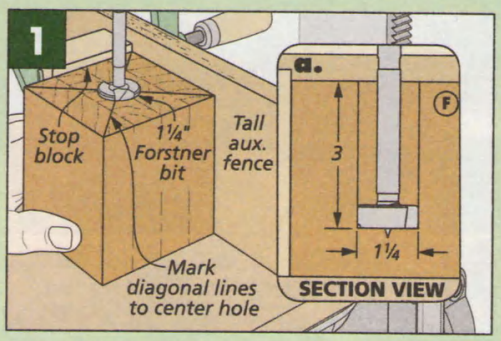
There's no easy way to clamp the curved parts while the glue dries. So instead, I relied on a series of dry assemblies that allowed me to test fit the joints, make any necessary adjustments, and work out an assembly procedure. I also mated a leg and spline pair with each hub groove and labeled them clearly.

The assembly begins by gluing (and clamping) each spline into its hub groove. Next, I marked the hub for the position of the top of each leg. I followed with a dry fit to complete the bolt holes and counterbores in the stretcher.

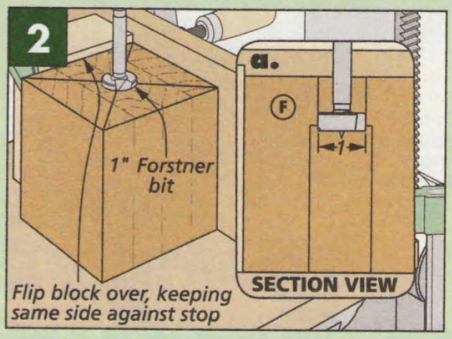
At this point, I got out the slow-set glue in order to bring it all together at once. Make sure the stretcher is in place when you glue the legs to the hub. You'll find that when you tighten the bolts and cap nuts, the legs will be pulled snugly against the hub. You should have time to adjust the vertical location of the leg on the hub if necessary.

Once the glue sets, you can complete shaping the splines with a file and sandpaper. Shoot for a flush fit and smooth transitions.

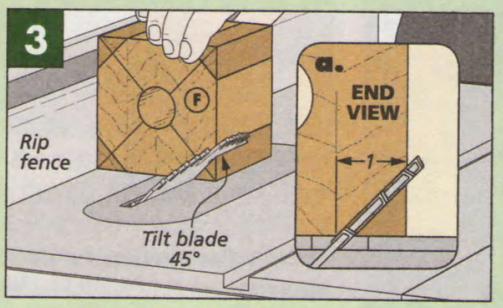
How-To: Make the Hub & Assemble



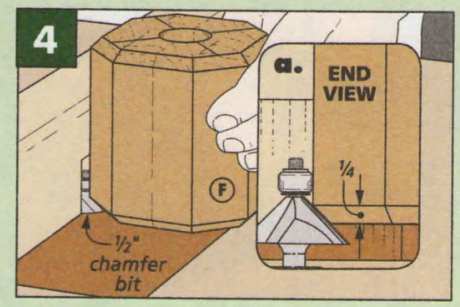
Insert Hole. *First, I drilled the larger and deeper hole in the hub for the insert. The key here is careful and accurate setup.*



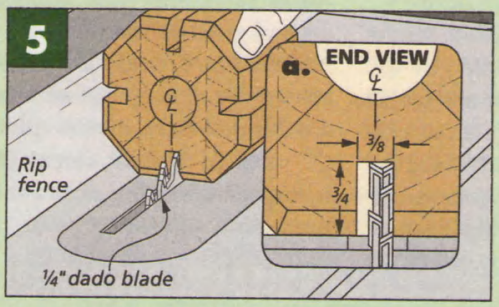
Guide Hole. *After switching to a smaller bit, flip the hub end-for-end and use the same setup to drill the guide hole.*



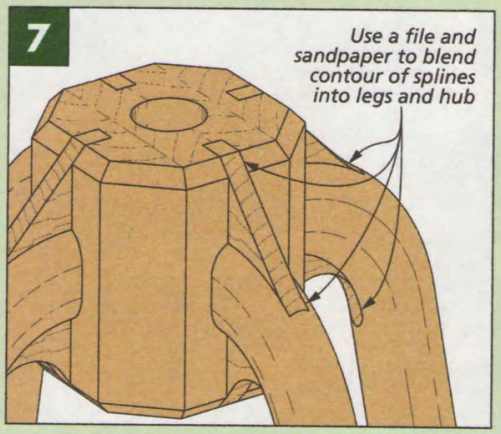
Bevel Cuts. *Next, I took the hub to the table saw to cut it to its final shape. You can use the same rip fence setting for all four cuts.*



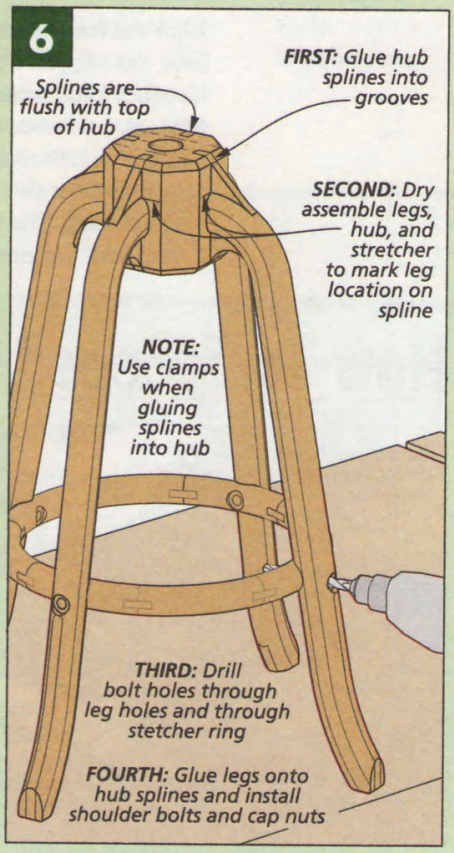
Chamfers. *For better control, I aligned the router table fence with the bit's bearing to chamfer the ends of the hub.*



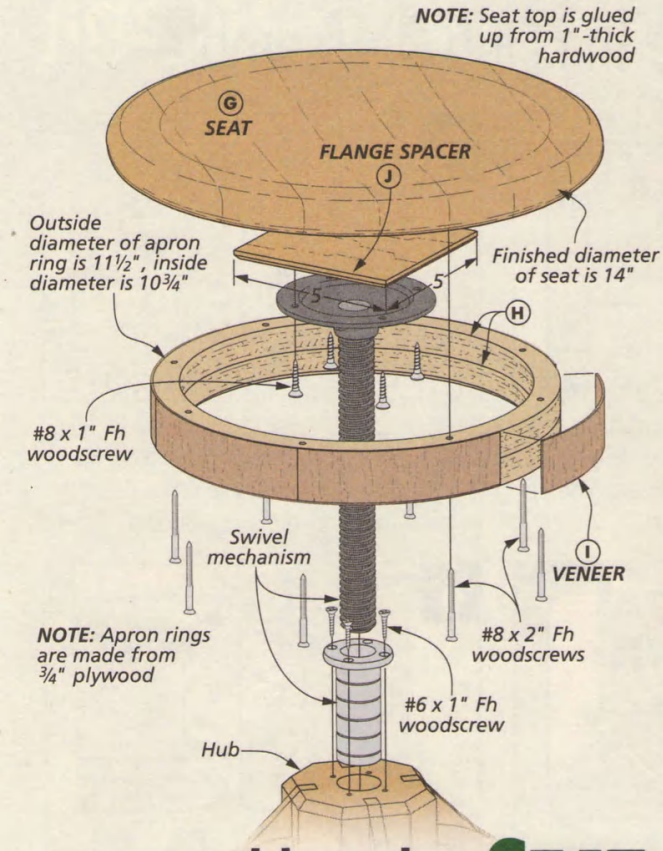
Grooves. *Flip the hub end-for-end between passes to center the groove. Adjust the fence to sneak up on a snug fit to the splines.*

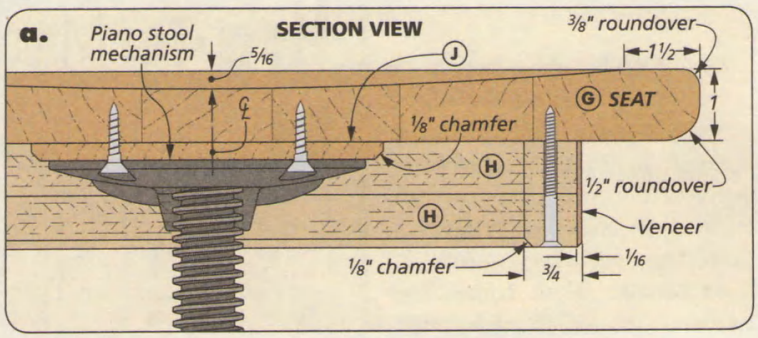


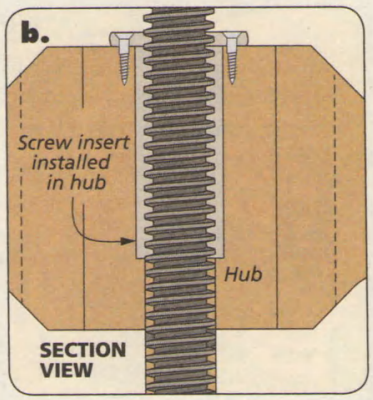
Fine Tuning. *The final step is to finish shaping the splines to blend smoothly into the top and bottom of the hub and the legs.*



The Assembly. *The key to a successful assembly is good preparation. Perform dry assemblies to work out any kinks.*







adding the SEAT

With the base assembled, you're over the biggest hurdle. All you have left to do is make and install the seat. And since you're already familiar with the use of the jig, this won't be difficult.

THE JOB AHEAD. The seat is actually a two-part assembly consisting of a circular top (the seat) with a recessed apron attached beneath it. The seat is hollowed slightly with the help of the jig. The apron is made by gluing up two ¾" plywood rings and then applying vertical grain veneer.

SEAT. First, I made the seat. I started by gluing up an oversized blank from narrow pieces (2" plus) of 1"-thick stock. This laminated assembly is simply a precaution against the seat cupping when it's scooped out.

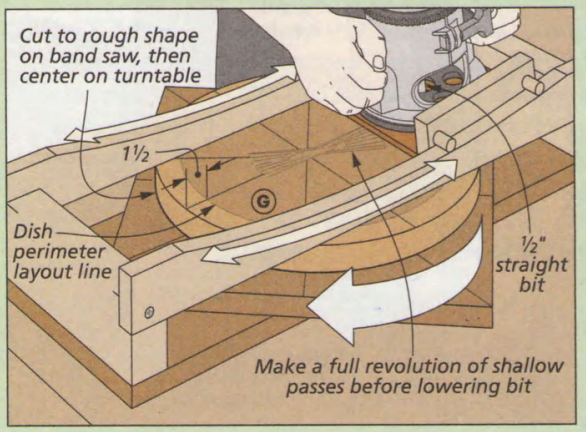
MAKE IT ROUND. When the glue was dry, I squared up the blank and marked it with the crisscrossing reference lines needed to center it on the turntable. Then I laid out the circular shape and drilled a starter hole for the router bit.

You know how things go from here. Cut the seat to rough shape at the band saw, attach it to the turntable with double-sided tape, and then trim it round.

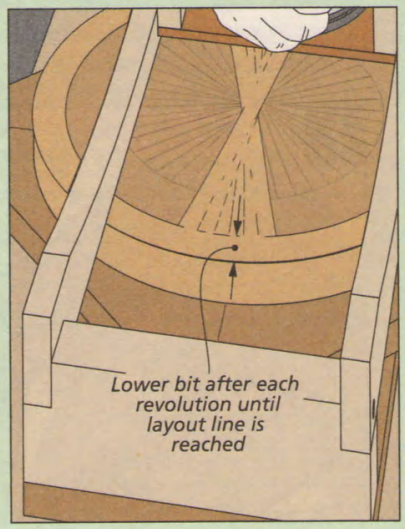
A SLIGHT DISH. The next step is to use the jig to hollow out the center of the seat top. This technique is a departure from the way you've used the jig before.

A look at the drawings below will give you the idea. Here the router carriage is not kept stationary. With the curved rails on the jig, you'll slide the carriage back and forth to cut a series of concave grooves. After multiple passes and a complete revolution of the top, you've created a surprisingly smooth, consistent hollow.

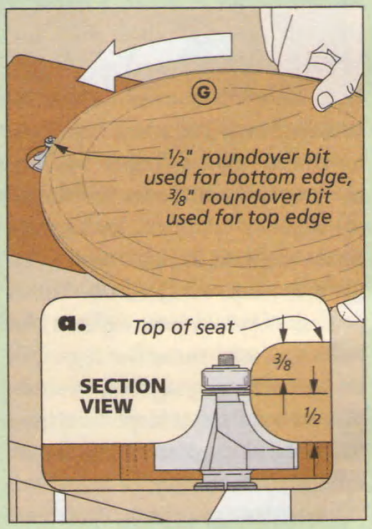
How-To: Scooped Seat



First Series. *The hollow is scooped out gradually. Start with the bit adjusted to take a shallow cut, then make a series of passes rotating the turntable in between.*



Final Series. *The final series of passes should leave the hollow just shy of the layout line.*



Roundovers. *The top edge has a ⅜" roundover while the bottom edge gets a ½" roundover.*

You want to leave a 1½"-wide flat area around the outside of the seat. So before starting, I laid out this border with a compass.

With the seat in the jig, set the straight bit to take a shallow cut and make a pass. Rotate the turntable slightly and make another. When the hollow is complete, lower the bit and repeat the process. The final series should leave you just short of the layout line. The milling marks left by the bit can be smoothed with sandpaper.

ROUNDOVERS. The upper and lower edges of the top are rounded over to make the seat more comfortable. You can use the same technique you used on the stretcher ring.

APRON RING. With the seat completed, you can now make and add the apron ring. The trick here is to use the jig to make one ring and then use this ring to flush trim the second ring to shape. This way the two rings will be identical in size. The steps are shown in the box at right.

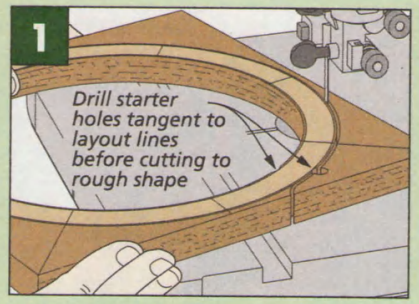
VENEER. The shop-made veneer is applied to the apron before it's attached to the seat. To make the veneer, I glued up sections of straight-grained oak into a wider piece and then sliced 1/16"-thick crossgrain pieces from it. You'll need about 38", but make extra.

I cut the veneer into shorter sections (about 6") for an easier piece-by-piece installation, as shown at right. Just work around the ring. I trimmed each piece flush at the top and bottom after it was added. Then before fastening the apron to the seat with countersunk screws, I chamfered the lower edges (detail 'a,' opposite).

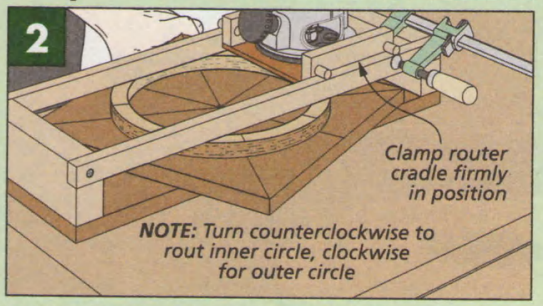
SPACER & SCREW FLANGE. Once you add the screw flange to the seat and the threaded insert to the base, you're done. Before attaching the flange, I glued a ¼"-thick spacer to the underside of the seat to give the screws more bite.

Now, I'm guessing you'll want to play a little bit before disassembling the parts for finish. That's okay. The finish can wait. W

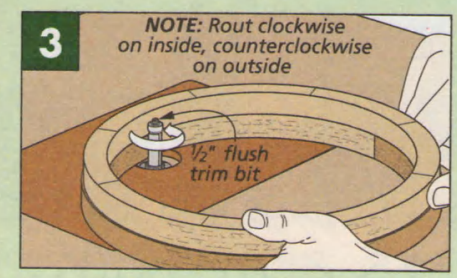
How-To: Make the Apron



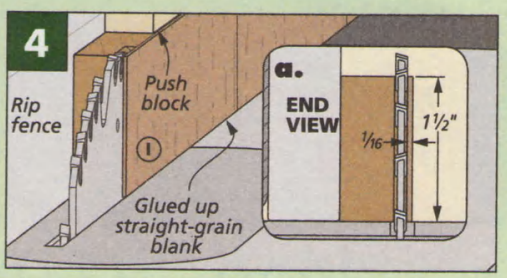
First Ring. *Start by sizing a plywood blank, laying out the ring, and then cutting it to rough shape.*



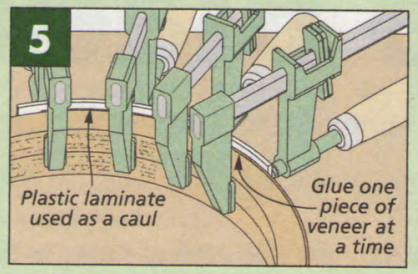
Rout to Shape. *Attach the ring to the turntable with double-sided tape and trim it perfectly round on both the inside and the outside.*



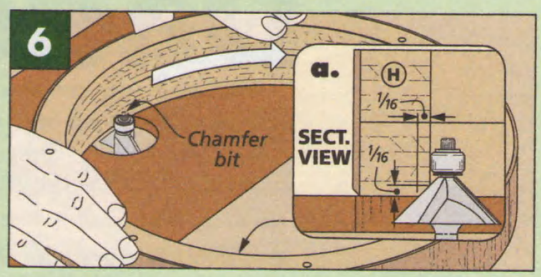
Second Ring. *After rough-cutting a second ring, glue it to the first, and then flush trim it to match.*



Shop-Made Veneer. *The crossgrain veneer can be cut from short, glued-up sections. I cut a piece from each edge of one face.*



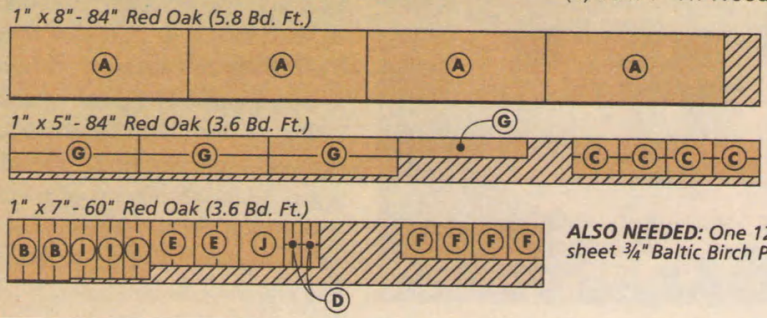
Piece by Piece. *Use clamps and glue to apply the veneer. A strip of flexible plastic laminate can serve as a caul.*



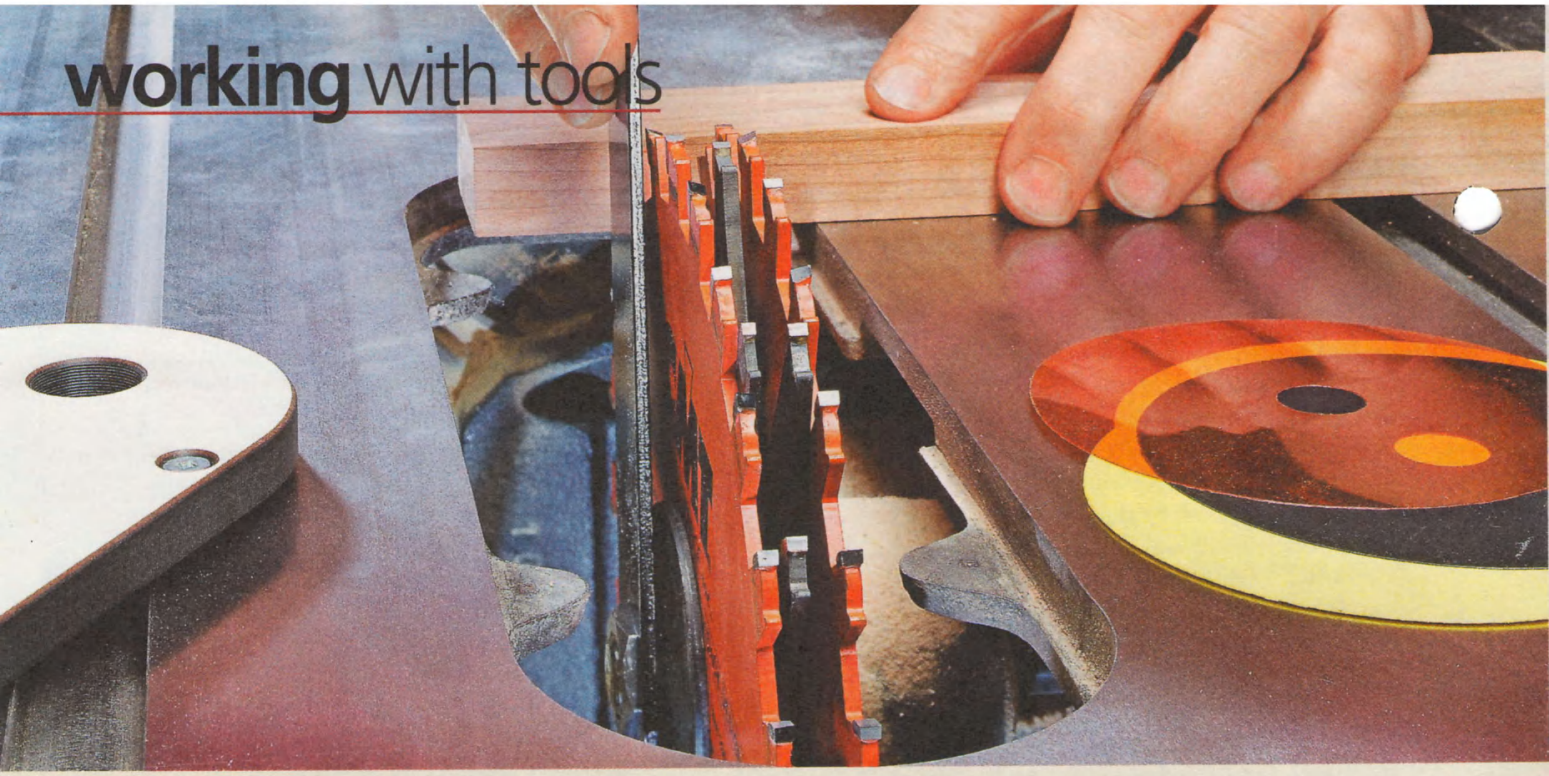
Chamfers. *To provide a more comfortable grip when adjusting the seat, I softened the lower edges of the apron ring with chamfers.*

Materials, Supplies & Cutting Diagram

A	Leg Blanks (4)	1 x 7 - 20
B	Leg Fillers (4)	3/8 x 6¾ - 1¾
C	Stretcher Ring Blanks (8)	1 x 2 - 5¼
D	Stretcher Ring Splines (8)	¼ x 1 - 2¼
E	Hub Spline Blanks (4)	3/8 x 4¾ - 2½
F	Hub (1)	4 x 4 - 4
G	Seat Blank (1)	1 x 14 - 14
H	Apron Ring Blanks (2)	¾ ply. - 12 x 12
I	Apron Veneer (1)	1/16 x 1½ - 38 rgh.
J	Flange Spacer (1)	¼ x 5 - 5
•	(4) 40mm Shoulder Bolts	
•	(4) Cap Nuts	
•	(1) Piano Stool Mechanism	
•	(8) #8 x 2" Fh Woodscrews	
•	(4) #8 x 1" Fh Woodscrews	
•	(4) #6 x 1" Fh Woodscrews	



ALSO NEEDED: *One 12" x 24" sheet ¾" Baltic Birch Plywood*



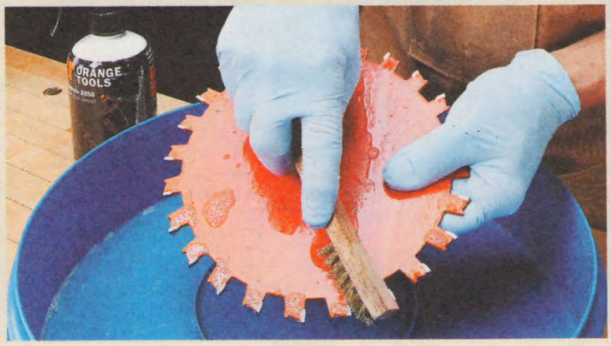
clean, accurate cuts with a Dado Blade

Once you learn a few simple techniques, tips, and guidelines, this essential table saw accessory can work magic.

A dado blade is undoubtedly the most versatile table saw accessory you can own. I turn to mine time and again for tasks ranging from simple rabbet cuts to complex joinery such as box joints. When set up and used correctly, a dado blade can make these cuts cleanly, smoothly, and with great accuracy. It just takes some basic know-how to ensure you get the best results from your dado blade.

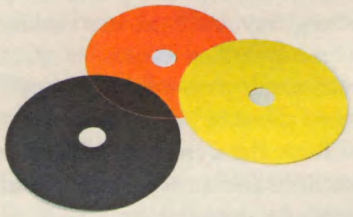
BLADE CARE. A clean, sharp blade will always make better cuts. Since a dado blade is not an "all-the-time" tool, it should stay sharp for a long time. But one thing you can do to guarantee this is to keep the blade clean. The scoring blades are your main concern. Just use a blade cleaning solvent along with a brass bristle brush or toothbrush to remove any built-up resin and gum.

▼ When you keep the blade clean, it will stay sharp longer and cut smoother.



ZERO-CLEARANCE INSERT. The one-size-fits-all dado insert that comes with the saw has a very wide opening that doesn't provide enough support for many cuts. You'll get cleaner shoulders if you install a zero-clearance insert that provides support right up to the point of the cut.

SHIMS. I find that shims are an indispensable part of dado blade setup. Without them, you're limited to the widths offered by a small number of scoring blade and chipper combinations.



▲ These color-coded shims allow you to fine-tune the width of your dado blade.

The plywood I use for projects is rarely the full specified thickness. So, in order to achieve tight joints, I use shims to custom-size the blade width to my material. The box on the opposite page shows an efficient way to do this.

A WIDE BLADE — FEWER CUTS. Many cuts don't necessarily require a blade of a specific width. Tenons are a good example. In these instances, it works best to size the blade to get the job done with the fewest number of passes.

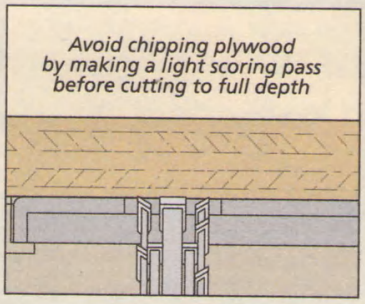
The two scoring blades are designed to cut a hair deeper than the chippers. So multiple narrow passes will result in lots of scoring marks. You'll get a much smoother result in less time by minimizing the number of passes.

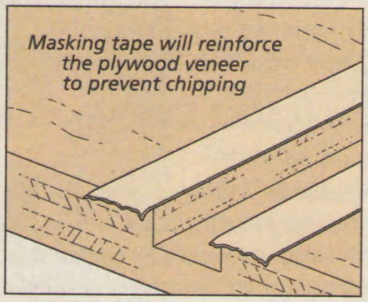
TEST CUTS. Test cuts are always part of my routine. They allow me to sneak up on the height setting as well as check for accurate width when necessary. It requires a few extra minutes up front, but always pays off in the end.

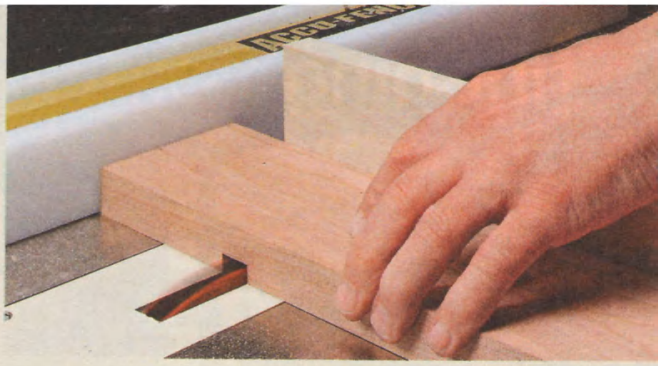
USE THE RIP FENCE. The rip fence is the dado blade's best friend. I almost always use the two together. When cutting a dado in a panel, the rip fence can be used to both guide the cut and position it. When cutting a tenon, I set the rip fence as a stop to gauge its length. It's a simple way to ensure accurate results and also consistent cuts from one workpiece to another.

BURY THE BLADE. Some cuts require you to bury the blade in an auxiliary rip fence. Rabbets are the most common example (right photo below), however short tenons can also be cut with a buried blade. Start by clamping a hardwood or plywood auxiliary fence to the rip fence. With the blade lowered below the table, position a portion of the auxiliary fence over it. Turn on the saw and raise the blade into the fence to the approximate depth of cut.

BACK UP CUTS. Since a dado blade is often removing a lot of waste, there's a high possibility of tearout as the blade exits the cut — both at the shoulders and bottom of the cut. This can easily be avoided by backing up the workpiece to provide support. You can use an auxiliary fence on the miter gauge or simply a piece of scrap held or clamped tightly behind the workpiece.







▲ The rip fence is used to locate the cut accurately while an auxiliary miter gauge fence prevents tearout.

AVOIDING SURFACE CHIPPING. Plywood and a dado blade may not get along very well. When making cuts across the grain, the blade tends to chip the thin veneer at the shoulders. Oak plywood is especially troublesome.

I can offer a couple of solutions. One is to start with a very shallow scoring pass — just enough to nick the surface of the plywood. A second option is to apply masking tape to the surface to reinforce the veneer (drawings at left).

GOOD CONTROL. A dado blade exerts a lot of force on the workpiece. So it's important to maintain good downward pressure. This will guarantee a full-depth cut. A featherboard clamped to the rip fence will also help (photo below). Likewise, make sure the workpiece is snug against the rip fence when making the cut.

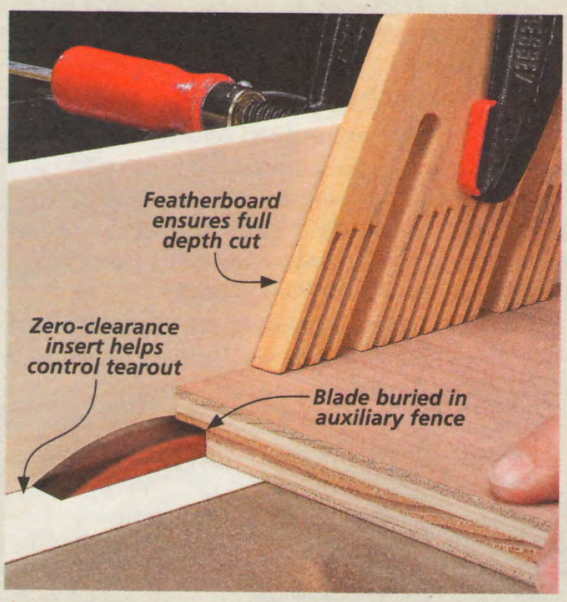
As you see, dado blade wisdom just involves taking a simple, common sense approach. W

Time Saver: Sizing Gauge

▲ Each slot in the MDF panel is labeled with the specific combination used to cut it.

Sizing a dado blade to match the thickness of a piece of plywood or even a hardwood part can be a trial and error process. I avoid this extra work by relying on a sizing gauge.

Whenever I cut a custom-size dado, I add a sample to the gauge and then log the specific combination of chippers and shims I used. To match a thickness, I test the workpiece in the slots until I find a good fit. Then I instantly know exactly which chippers and shims to install.



▲ A rabbet is cut with the dado blade buried in an auxiliary rip fence. The featherboard helps ensure the cut is full depth.

a guide to choosing Outdoor Finishes

Sun, moisture, heat, cold — outdoor projects have a lot of enemies. The right finish can help protect the wood and keep it looking great.

Whether it's on the patio, deck, or front porch, wood projects often look as good outside the home as they do inside. The only problem is, protecting outdoor projects can be a daunting task.

Greater humidity and temperature fluctuations cause wood to expand and contract more than it does indoors. This can make finishes fail more quickly. And while the right finish can block out rain and snow, over time the elements will take their toll.

CHOOSING THE RIGHT FINISH. The best defense is to choose an outdoor finish that can stand up to the elements and keep your project looking great for years. Of course, it's also important to realize that no outdoor finish is entirely worry-free. If you want your piece to last for decades, regular maintenance will be required no matter which finish you choose.

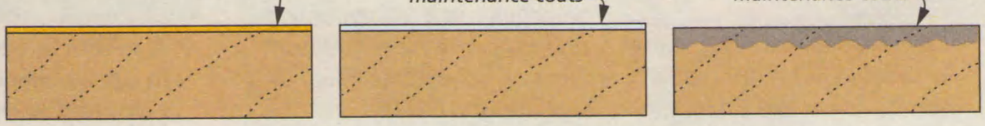
FINISH TYPE

Despite all the choices available at stores, wood finishes for outdoor use filter down to three basic categories: paint, film-building finish, and penetrating oil.

PAINT. With its opaque film and additives for stopping the sun's ultraviolet (UV) rays, mildew, and fungus, exterior-grade paint offers great protection for outdoor projects. Of course, the drawback to paint is that it doesn't do much to show off the beauty of the wood. Still, it's a good choice for projects like porch swings, Adirondack chairs, or benches.

FILM-BUILDING FINISH. If you you're looking for good protection but still want to enjoy the natural beauty of wood, film-building finish is a strong option. These products are often sold with names like spar varnish, marine varnish, or exterior polyurethane.

▼ Both oil and film-building finishes protect outdoor wood projects.



A film-building finish is quite similar to a varnish or polyurethane used indoors. Just like those products, these finishes build up in layers on top of the wood to form a barrier that keeps moisture out. The difference is they have UV blockers and are more flexible to withstand outdoor extremes.

The advantage of this type of finish is that it lasts anywhere from three to five years. The only problem is that when the finish starts to wear, reapplying it requires sanding off the old finish and removing the dust before applying fresh coats of varnish.

People often think of varnish as a clear finish. But if you want to add a little pop of color to the wood, companies like *General Finishes* and *Sikkens* offer film-building finishes with a tint mixed in. The added pigment offers greater UV protection.

PENETRATING OIL. The third choice for an outdoor finish is penetrating oil. If film-building finish is similar to varnish, you can think of penetrating oil like an oil finish or even a wood stain. Rather than forming a film on top of the wood, it penetrates into the wood to keep water from soaking in. The only difference with the products for exterior use is that they often have added water repellants and UV blockers. These products are sold with names like deck stains, water sealers, or outdoor oil.

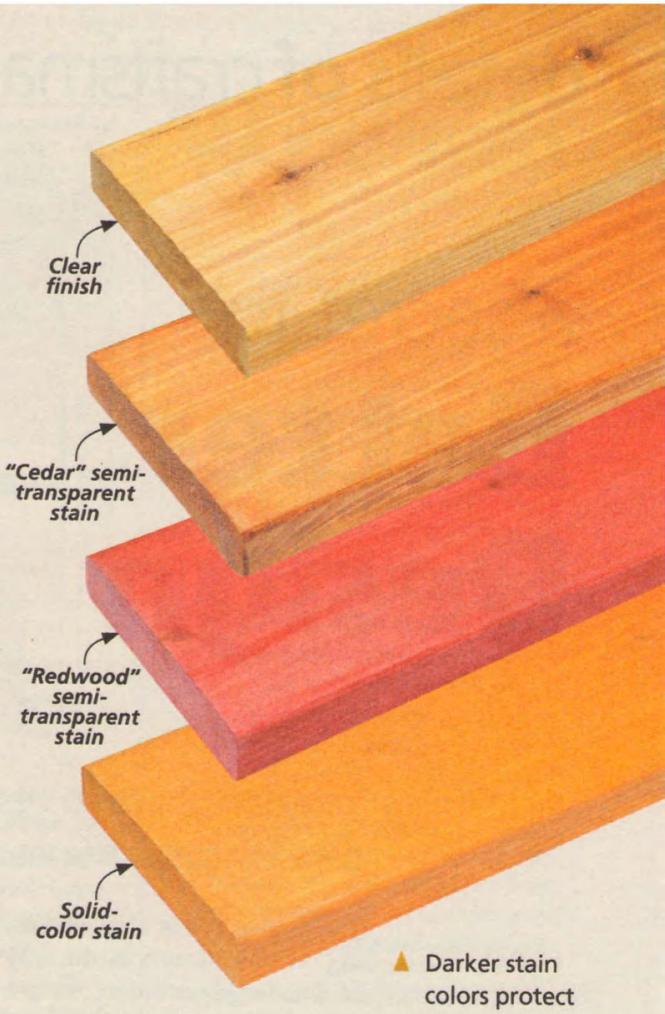
Penetrating oils are easy to apply. You just spray, brush, or roll them on. They tend not to last as long as film-building finish, though. Over time, the oils dry out and leave wood unprotected. But reapplying oil every couple of years only requires cleaning the wood and applying a fresh coat.

FINISH COLOR

Along with finish type, another consideration is the color, or tone, of the finish. The darker, or more richly pigmented the color is, the more protection it will offer from the sun's harmful UV rays.

Of course, you also need to keep in mind that the darker the color, the more it's going to mask the natural beauty of the wood. Often, there's a happy medium that can offer both protection and a nice look. For example, cedar looks good with a subtle red or brown tone.

Along these lines, you can expect a clear finish to offer the least protection against UV rays. A semi-transparent stain imparts a tone to the wood while still letting the grain show through, and it offers better protection. And a solid-color stain is almost like a thin, penetrating paint. It completely conceals the wood and offers the best protection.



▲ Darker stain colors protect wood better, but they also obscure the wood grain.

You can see examples of these in the photos above.

No matter which finish you choose, you'll still need to apply maintenance coats to keep your project protected. But if you find a pigmented finish you like, it might offer a little better protection that can buy you a bit of extra time between coats. W

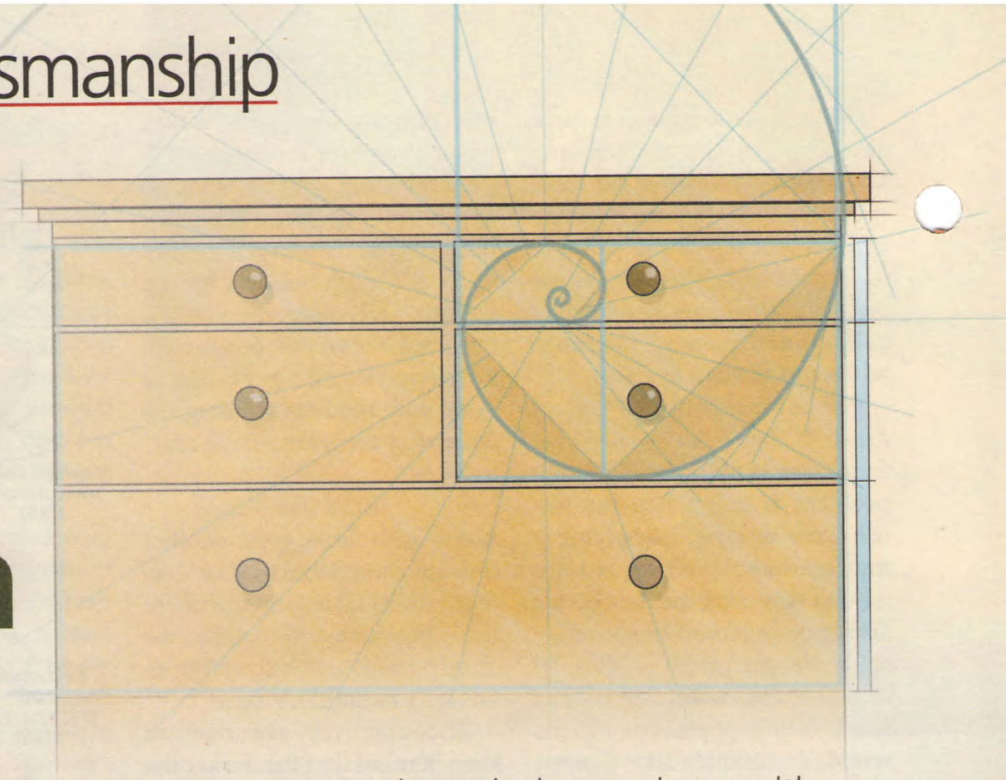
The Ultimate in Protection: Epoxy Finish

It may seem like there's little you can do to enhance the durability of an exterior wood finish. But there is one trick that can work, and boat-builders have been using it for decades. That's to apply an epoxy coating to the wood prior to applying a top coat of varnish or paint.

To use epoxy this way, you'll need to get a product designated as an epoxy coating rather than one that's specifically an adhesive. *West System* is one good example. Mix it as directed and brush it onto the wood first. As it dries, the epoxy penetrates into the wood's pores and hardens them, making the surface more durable. Then apply the topcoat.

The only drawback is that epoxy can be a bit pricey. But if you want to be sure that a project will stand the test of time, an epoxy coating may just be a wise investment.

a secret to Better Design



You don't have to resort to guesswork to design projects with pleasing proportions. Simply apply the lesson of the masters.

The human eye is very discerning. Without much in the way of detailed observation, we can quickly form a general impression as to what looks right and what doesn't. Most woodworkers knows this from experience. When a project is completed and you stand back and critique your work, a pleasing overall result is quickly apparent.

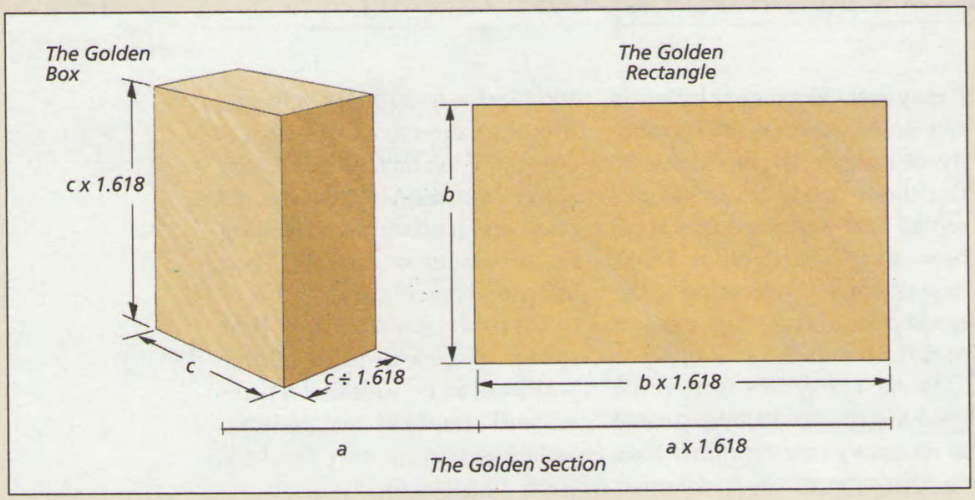
What is it about a project that creates this immediate impression? Often, it's the overall proportions of the project as well as those of the individual elements or details. When you get this part of the design right, the rest is sometimes just window dressing.

This begs the question, how can I guarantee that the proportions of a project will look right once it's completed? Shop drawings or even three-dimensional, computer-generated plans can be a help. But you still need a starting point, and not many of us have the ability to instinctively visualize these pleasing proportions in our minds.

The good news is that there's a design standard you can draw upon that's been used for literally several thousand years — the golden ratio (also called the golden mean or golden section). It's a mathematically derived ratio that you can use as a basic guideline to define the relationships between the dimensions of a project and its parts.

WHAT. I won't try to explain the mathematical basis of the golden ratio. Honestly, it's beyond my understanding. But the ratio itself isn't too difficult to grasp. For design purposes, the golden ratio basically defines the relationship between two sections of a line. The line is divided into two parts such that the longer section is 1.618 times the length of the shorter section. Furthermore, the ratio between the longer section and the overall length of the line is also 1.618. So really all you have to remember is the golden ratio works out to 1.618. This is often referred to as *phi*.

The golden ratio can also be used to create a golden rectangle. The length of the long side is 1.618 times the length of the short side. And likewise, a golden box can be constructed using *phi*. The depth of the box is dimensioned by dividing the short side



by 1.618. The drawings at the bottom of the opposite page show all these relationships.

WHY. What's so special about the golden ratio? Well beyond its status as a mathematical curiosity, designs based on the golden ratio are simply pleasing in proportions. The ratio or its approximation is often found in nature and many of the things we encounter in our daily life. Architects and artists have been using the golden ratio as a tool for centuries. The elements of the Parthenon in ancient Athens are thought to be based on the golden ratio. And for cabinetmakers, it provides a reliable way to determine the proportions of a project and its details.

WHERE & HOW. In some ways, the golden ratio is intuitive. It's probably become fixed in our brains from years of observation. But when you make a conscious decision to rely on the golden ratio for design decisions, there's less guesswork involved, and the job becomes a lot easier.

The drawings at right provide a few good examples. When designing a case piece, the golden ratio can be used to determine the overall dimensions — width, height, and depth. This can apply to both a tall, vertical cabinet, such as an armoire, or a horizontal case like a buffet or credenza.

When a case is divided into sections, such as the step-back cabinet shown at upper right, the individual elements can be scaled to the golden ratio. Here, the height of the upper and lower cases are related by the golden ratio. Similarly, the open section of the upper case and enclosed section are scaled to the golden ratio. As you can see, the result is both practical and pleasing to the eye.

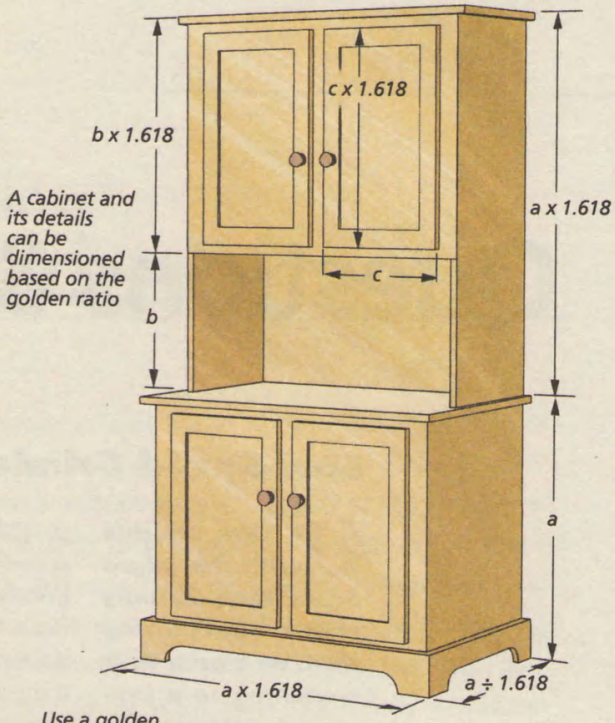
As shown in the lower drawing at right, a table is also a good candidate. Both the dimensions of the table base and the top can be scaled to the golden ratio.

THE DETAILS. The individual elements of a case can also be sized using *phi*. As you see at right, a door (or door panel) based on *phi* looks very natural. And the scale is functional. Graduated drawers or shelves offer another opportunity to put the golden ratio to work. In the main drawing on the opposite page, the height of each drawer and the one above and below it are related by *phi*.

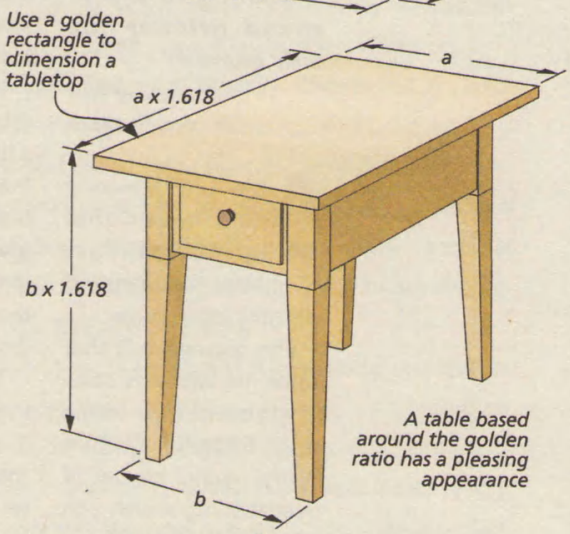
PRACTICALITY FIRST. The use of the golden ratio is a case where close is good enough. When you think about it, 1.618 is pretty close to 1.5. This approximation works out to a two-to-one ratio or a ⅔ to ⅓ division. All you really need to do is be in the ballpark.

Furthermore, I don't want you to think that all good furniture design has to revolve around the golden ratio. This is far from the truth. Many times function, structure, and space limitations are overriding concerns when it comes to dimensioning a piece. And these practical considerations should always come first. There's no point in building a project that doesn't fill your needs or fit the space available.

I've always believed that coming up with a good project design can sometimes be the most difficult part of woodworking. So why not ease the process by taking full advantage of a proven guideline like the golden ratio? W



A cabinet and its details can be dimensioned based on the golden ratio

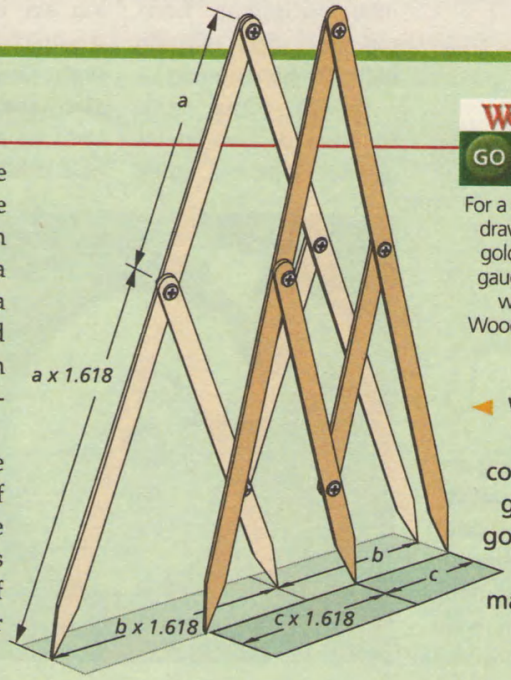


A table based around the golden ratio has a pleasing appearance

Design Tool

A quick way to work out the details of a design with the golden ratio is to use a golden section gauge. It looks like a compass with a couple of extra arms. The gauge is constructed so that the distance between the three points always corresponds to the golden ratio.

The trick is that the distance between the pivot points of the gauge are based on the golden section. As long as this ratio is maintained, the size of the gauge can be scaled up or down to meet your needs.



When you extend or contract the gauge, the golden ratio is always maintained.

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For a dimensioned drawing of the golden section gauge, visit our website at Woodsmith.com.

Questions & Answers

Low-Speed Grinders

Q ***I have trouble with the edges of my tools burning when sharpening them on a grinder. Is switching to a low-speed grinder the only answer?***

Guy Rule
Mexico, Missouri

A It's a commonly held notion that low-speed grinders are better for grinding woodworking tools.

The argument is that since the wheel is spinning slower, it develops less friction. Friction is the main cause of overheating, which can draw the temper from the steel and ruin its ability to hold an edge.

There's some truth to this. A low-speed grinder typically spins at 1725 RPM; half the speed of a "high-speed" grinder. So it does produce less friction. But it's still possible to ruin the edge of a tool on a low-speed grinder — just not as quickly.

What a low-speed grinder does is buy you a little extra time before the tool heats up to the point of no return. This gives you a chance to stop grinding and let the tool cool off before disaster strikes.

Think of it like driving a car on a wet road. If you're driving at 30 mph, you'll have a better chance of avoiding an accident than if you're driving at 60 mph. Of course, it will also take you twice as long to arrive at your final destination.

► Installing a high-quality wheel is one of the best improvements you can make to your grinder.

▲ A bench grinder excels at removing metal quickly. But it can also ruin the edge of a tool by drawing the temper if not used properly.

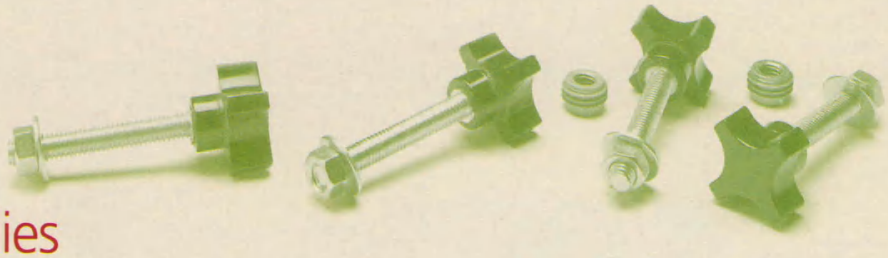
AN ALTERNATIVE. Before ditching your high-speed grinder, I'd like to suggest a different approach. I've used high-speed grinders for years and not only do they grind much faster but it's possible to get excellent results when using one. The key is using the right grinding wheel and focusing on your technique.

GRINDING WHEELS. The hard, gray grinding wheels that are supplied with most grinders aren't really suited for grinding woodworking tools. One of the best improvements you can make to your grinder is to invest in a quality, aluminum oxide grinding wheel (photo at left). Or even better, a *Norton 3X* wheel (see Sources on opposite page).

These wheels are friable, meaning the abrasive particles break down as you grind so the surface doesn't get glazed with metal particles. (Glazing is a major cause of friction and heat build-up.)

GRINDING TIPS. The second part of the equation is technique. A lot of this comes with experience. But the most important thing is to use a light touch when grinding and let the wheel do the work. Rather than holding the the tool in one spot, keep it moving across the face of the wheel.

It's a good idea to have a cup of water on hand to dip your tool into when it starts to heat up. And dip it frequently. With a just little practice, you'll be grinding tools like a pro. W



hardware & supplies

Sources

Most of the materials and supplies you'll need to build the projects are available at hardware stores or home centers. For specific products or hard-to-find items, take a look at the sources listed. You'll find each part number listed by the company name. See the right margin for contact information.

The *Woodsmith Store*, in Des Moines, Iowa, is an authorized *Rockler* dealer. They carry many of the hardware items used in our projects. And they ship nationwide. Their customer service representatives are available for your calls from 8am – 5pm Central Time, Monday through Friday.

TIPS & TECHNIQUES *(p.4)*

- **Rockler**

20mm Magswitch. 21910
¼"-20 Star Knobs 23804
¼"-20 Studded Knob 23838

SHOP MATS *(p.10)*

- **Uline**

⅜" Cadillac Mat. H-51Y
½" Bubble Mat. H-2581
⅝" Anti-Fatigue. H-882BL
1" Kneeling Mat. S-15968

Hard rubber, interlocking floor tiles similar to the ones shown in the article are available in several different sizes and thicknesses from *GreatMats.com*.

MORTISE & TENON JIG *(p.12)*

- **Rockler**

General E-Z Pro Jig 48976
Bessey In-Line Clamp 45572

BOX HINGES *(p.16)*

The hinges featured in this article were purchased from several sources. *Rockler* carries a large selection of small butt hinges, continuous hinges, and barrel hinges. *Lee Valley* stocks several sizes of *Brusso* hinges. The barbed hinges and slotting saw blades and arbor were purchased from *Woodcraft*.

FLAG CASE *(p.18)*

- **Rockler**

1¼" x ½" Box Hinges . . . 70391

The flag case was stained with *General Finishes' Brown Mahogany* gel stain and finished with two coats of lacquer. The brass, glass, foamcore board, and fabric were purchased locally.

WALL DESK *(p.26)*

- **Lee Valley**

Stainless Steel Knobs . . 01W63.50

The desk was stained with a mixture of three parts *Zar* and one part *Woodkote Jel'd Stain* (both cherry). Then it was sprayed with two coats of lacquer.

SHOP STOOL *(p.34)*

- **Lee Valley**

Piano Stool Mechanism 01K71.01
40 mm Shoulder Bolts . 00N14.40
Cap Nuts. 00N20.17

The stool was given a single coat of wiping varnish and sprayed with two coats of lacquer.

OUTDOOR FINISHES *(p.46)*

- **Rockler**

West System Epoxy . . . . . Varies

BENCH GRINDERS *(p.50)*

Norton 3X grinding wheels are available in a range of sizes and grits from *Amazon*, *Tools for Working Wood*, and *Woodcraft*.

MAIL ORDER SOURCES

Project supplies may be ordered from the following companies:

Woodsmith Store
800-444-7527

Rockler
800-279-4441
rockler.com

Amazon
amazon.com

GreatMats.com
877-822-6622

Lee Valley
800-871-8158
leevalley.com

Tools for Working Wood
800-426-4613
toolsforworkingwood.com

Uline
800-958-5463
uline.com

Woodcraft
800-225-1153
woodcraft.com

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looking inside

Final Details

► *Flag Case.* This elegant flag case is certainly befitting of the contents it holds. And an optional stand provides a convenient base for display. Take a look at the plans starting on page 18.

▲ *Shop Stool.* With its graceful curves and adjustable seat, this stool is a big upgrade over the metal shop stools you may be used to. We'll walk you through every step of the construction, starting on page 34.

▼ *Wall Desk.* Mounted directly to a wall, this space-saving desk offers a convenient place for jotting down a quick note or using a laptop computer. You'll find complete plans beginning on page 26.